U.S. DEPARTMENT OF COMMERCE
National Technical Information Service

PB-263 941

Fluorine, Its Compounds, and Air Pollution: A Bibliography with Abstracts

Environmental Protection Agency, Research Triangle Park, N C

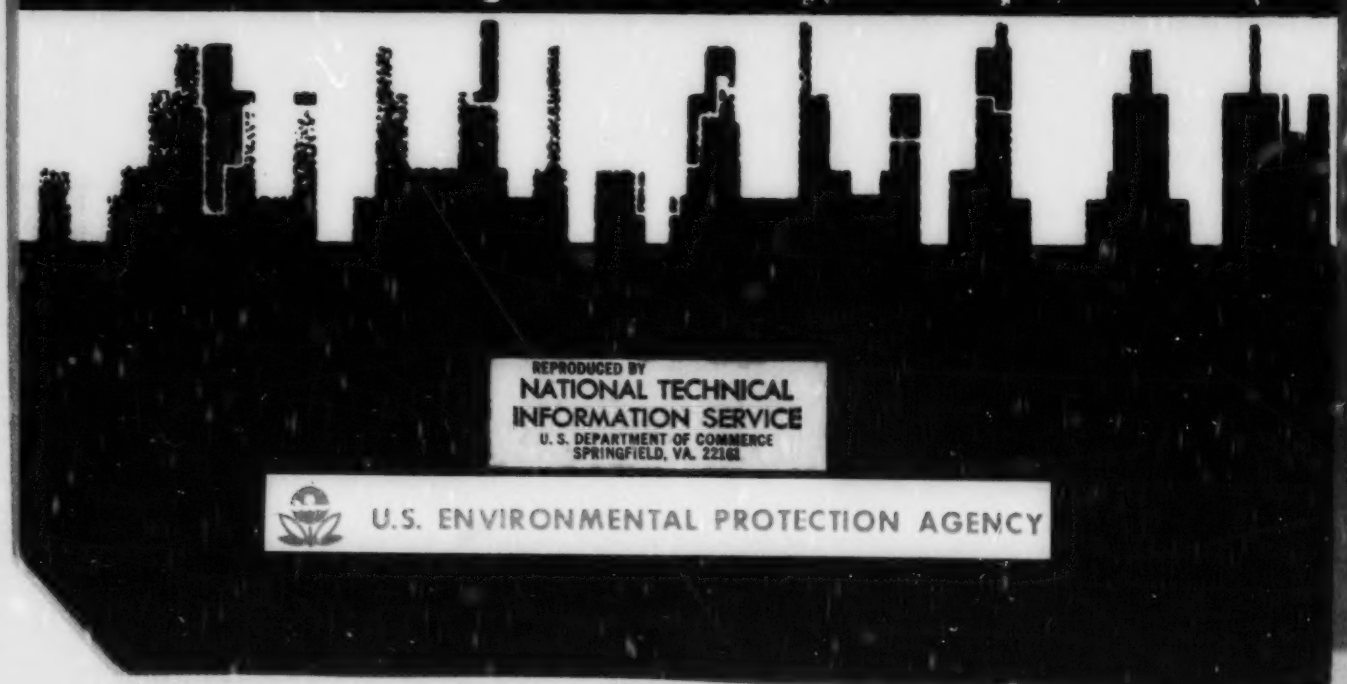
Dec 76

PB 263 941

EPA-450/1-76-003
December 1976

FLUORINE, ITS COMPOUNDS, AND AIR POLLUTION

A BIBLIOGRAPHY WITH ABSTRACTS



REPRODUCED BY
NATIONAL TECHNICAL
INFORMATION SERVICE
U. S. DEPARTMENT OF COMMERCE
SPRINGFIELD, VA. 22161

U.S. ENVIRONMENTAL PROTECTION AGENCY

EPA-450/1-76-003

FLUORINE, ITS COMPOUNDS, AND AIR POLLUTION: A BIBLIOGRAPHY WITH ABSTRACTS

ENVIRONMENTAL PROTECTION AGENCY
Office of Air Quality Planning and Standards
Research Triangle Park, North Carolina 27711

December 1976

This report is published by the Environmental Protection Agency to report information of general interest in the field of air pollution. Copies may be purchased from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402

Publication Number EPA-450/1-76-003

CONTENTS

INTRODUCTION v

ANNOTATED BIBLIOGRAPHY

A. Emission Sources 1
B. Control Methods 73
C. Measurement Methods 146
D. Air Quality Measurements 232
E. Atmospheric Interaction 256
F. Basic Science and Technology 263
G. Effects - Human Health 271
H. Effects - Plants and Livestock 329
I. Effects - Materials 480
J. Effects - Economic 485
K. Standards and Criteria 489
L. Legal and Administrative 499
M. Social Aspects 517
N. General 518

AUTHOR INDEX 525

SUBJECT INDEX 541

FLUORINE, ITS COMPOUNDS, AND AIR POLLUTION:

A BIBLIOGRAPHY WITH ABSTRACTS

INTRODUCTION

The Air Pollution Technical Information Center (APTIC)* of the Office of Air Quality Planning and Standards, U.S. Environmental Protection Agency, has prepared, selected, and compiled the approximately 2600 abstracts in this bibliography. The abstracts are arranged within the categories listed in the Contents. The abstracted documents are thought to be representative of available literature, and no claim is made to all-inclusiveness.

The subject and author indexes refer to the abstracts by category letter and abstract number. Generally, higher numbers have been assigned to more recent documents. The author index lists all authors individually; primary authorship is indicated by an asterisk.

This bibliography brings together relevant abstracts that were previously scattered throughout "Air Pollution Abstracts" (1970-1976).

All of the documents abstracted by APTIC are on file at the library of EPA, Research Triangle Park, North Carolina 27711. Readers outside EPA may seek the documents directly from publishers, authors, or libraries.

*Now re-organized into the Manpower and Technical Information Branch.

Preceding page blank

A. EMISSION SOURCES

00220

J. P. Sheehy, J. J. Henderson, C. I. Harding, and A. L. Danis

AIR POLLUTION IN JACKSONVILLE, FLORIDA (A PILOT STUDY - AUG.-SEPT. 1961). Public Health Service, Cincinnati, Ohio, Div. of Air Pollution (AP-3). Apr. 1963. 65 pp. GPO: 802-899-6

The objectives of this pilot study were: (1) To develop a preliminary opinion as to whether the city of Jacksonville has a generalized air pollution problem. (2) To determine whether certain pollutants - fluorides and SO2, were present in the atmosphere in concentrations capable of producing the damage to vegetation that had been experienced in the Jacksonville-Duval County area. To accomplish the first objective, a one-week intensive investigation was carried on in downtown Jacksonville, at (emming Park, from August 3 to 10, 1961. To accomplish to second objective, additional studies were conducted during the periods August 4 to 12, and September 5 to 13, 1961, in the area in which damage to vegetation had occurred. The two fertilizer plants, located in the industrial area of Jacksonville, were not in production during the first phase of this study. Pollutants sampled in this study included fluorides, SO2, H2S, NO2, nitrogen dioxide, and particulates. As a result of the investigations it was concluded that: (1) Photochemical smog was being produced in the air over Jacksonville. (2) Concentrations of fluorides occurred in certain parts of Jacksonville during the period of the study that could cause damage to sensitive plants. (3) Pollutants from the city of Jacksonville can be transported across the St. John's River. H2S concentrations measured during this study were not of the magnitude known to cause discoloration of paints containing lead pigments and/or mercury base fungicides. Subsequent to the study, an incident of darkening of paints occurred in the arlington area. Therefore, it is evident that an H2S problem exists in this area. SO2 concentrations observed during this study did not reach levels known to cause damage to vegetation. However, it appears possible for SO2 concentrations to reach levels during the heating season capable of causing damage to sensitive plants, particularly in localized areas downwind of major sources of SO2.

00340

K. K. Huffstutler and W. E. Starnes

SOURCES & QUANTITIES OF FLUORIDES EVOLVED FROM THE MANUFACTURE OF FERTILIZER & RELATED PRODUCTS. Preprint. J. Air Pollution Control Assoc. 11, (12) 682-4, Dec. 1966. (Presented at the 59th Annual Meeting, Air Pollution Control Association, San Francisco, Calif., June 20-24, 1966, Paper No. 66-8.)

Fluoride emission levels from the manufacture of phosphoric acid, run-of-pile triple superphosphate, diammonium phosphate and granular triple super-phosphate are presented in tabular form. The information is discussed together with variations and unusual layouts or operating conditions. In addition, fluoride emissions from the manufacturing of such products as defluorinated and calcined phosphate rock, normal superphosphate, superphosphoric acid and elemental phosphorus are discussed. The information applies to the fertilizer and related phosphate products manufactured in Polk and Hillsborough Counties in Florida. This area produces 75% of the marketable phosphate rock in the United States. Some 40% of the rock remains in these two counties for chemical or thermal processing. The phosphate industry is required to report annually on fluoride emission levels found by their sampling and monitoring programs. These values are compared with those found by spot checking various sources by the Florida State Board of Health. (Author)

00375

R. A. Prindle

AIR POLLUTION AND COMMUNITY HEALTH (CHAPTER EIGHTEEN). Medical Climatology 505-18, 1964.

In this chapter author reviews major pollution episodes which have occurred since 1930 in various parts of the world. These episodes have demonstrated the danger and the lethality that may result when certain meteorologic phenomena occur in geographical areas where potentially high concentrations of air pollutants may form. Certain pollutants that might be tolerated in low concentrations in some inhabited areas might become dangerous when mixed with pollutants from other sources that could exert an accentuating or synergistic action. SO2, particulates, CO, beryllium, lead, fluoride, photochemical, and allergenic pollutants and their effect on man and animals are discussed. The most important animal experiments as well as other research are reviewed.

00640

P. M. Ricca

EXPOSURE CRITERIA FOR FLUORINE ROCKET PROPELLANTS. Arch. Environ. Health Vol 12:399-407, Mar. 1966. (Presented at the Fourth Inter-American Conference on Toxicology and Occupational Medicine at Miami Univ., Fla., Aug. 24-27, 1964.)

A subject of considerable interest is the use of liquid fluorine for propulsion because it is the most powerful of all the chemical oxidizers. Space vehicles currently in the developmental stage utilize elemental liquid fluorine (LF2) as well as liquid fluorine and liquid oxygen (FLOX) mixtures. Rocket testing with, and handling of, fluorine oxidizers call for the utmost care and consideration for the health and safety of personnel. Although closed and zero-loss handling systems are used, total and complete containment of all fluorides is generally infeasible. Environmental releases can come from engine exhaust gases, burned purge gases, and accidental discharges from pipe burnouts and spills. Because releases to the atmosphere, either normally or accidentally, usually involve F2/HF mixtures, industrial hygiene controls and site planning are based on toxicity criteria for HF and F2. (Author Abstract)

00896

E. Weber

(ANNUAL REVIEW OF THE PURIFICATION OF THE AIR (SECOND SERIES).) Jahresubersicht Reinhaltung der Luft (2. Folge). Giesserei (Duesseldorf) 53(12):405-410, June 9, 1966

This a comprehensive review of air purification problems with 116 references, mainly from the German literature. Articles reviewed include government regulations in various countries, aspects of dust and gas accumulations, disposal of fluorine and sulfur compounds in the air, maximum concentration permissible in working areas, and measurement of emission of gases.

01125

D. Zanon and D. Sordelli

PRACTICAL SOLUTIONS OF AIR POLLUTION PROBLEMS FROM CHEMICAL PROCESSES . (Realizzazioni nel Campo della Prevenzione dell' inquinamento Atmosferico di Origine Industriale.) Translated from Italian. Chim. Ind. (Milan), 48(2):251-261, March 1966.

A strict control of pollutant to be dispersed in the atmosphere offers technical and economic problems, both in the design and the operation of chemical processing units. Three examples of processes for which pollution control has been established are described: SO2 derived from contact sulfuric acid and from hydroxylamine sulfate plants, nitrous gas from low and high-pressure nitric acid plants, and fluorine-containing effluents from hydrogen fluoride production. The general approach, kind of abatement process adopted, materials and construction costs are discussed.

01528

K. Guthmann

(NEW KNOWLEDGE AND EXPERIENCE IN THE PURIFICATION OF AIR IN FOUNDRIES.) Neue Erkenntnisse und Erfahrungen bei der Reinhaltung der Luft in Huttenwerken. Radex Rundschau (Austria), No: 3: 139-162, June 1966.

German laws, passed by the Federal Government, requiring maintenance of clean air, are discussed. Maximum allowable emission values for dusts, gases, and smokes are given. Programs established for research on the measurement of dust and SO2 and warning devices for smog are described. Other research described is being conducted on the removal of brown smoke in basic steelworks and oxygen-blowing steelworks, recovery of converter gas, possibilities for utilizing accumulated dust, removal of fluorine from exhaust gases and removal of odor from exhaust gases.

01687

S.C. Rothman

ENGINEERING CONTROL OF INDUSTRIAL AIR POLLUTION: STATE OF THE ART, 1966. Heating, Piping, Air Conditioning Mar. 1966. 141-8 pp. (Presented before the First World Air Pollution Congress, Buenos Aires, Argentina, Nov. 1965.)

Problems encountered by the engineer are illustrated through analysis of air pollution control in the aluminum production industry. Prebaked pots and Soderburg pots and their fluoride emissions are considered.

02019

E.R. Hendrickson, J.S. Lagarias

CONTROL OF AIR POLLUTION FROM PHOSPHATE PROCESSING. Proc. (Part I) Intern. Clean Air Cong., London, 1966. (Paper IV/7). PP. 97-9.

Phosphorus is one of the elements essential for the growth of human, plant and animal life. Most phosphate ores must be treated in some manner to make the phosphorus soluble and thus available for life, usually by addition of acid or by heating. One-third of the world's phosphate is processed in Florida, where practically all the products normally made from phosphorus rock are produced. This results in a variety of air pollution problems involving particulates, fluorides and sulphur oxides. The manufacturing processes and sources of pollutants are described briefly. Further described are the general effects of the emissions. Based on the experience of a number of years of investigation and application, procedures for alleviating the air pollution are discussed. The sequential application of these procedures has resulted in a substantial reduction in contaminant emissions. (Author abstract)

02312

AIR RESOURCES OF UTAH. Utah Legislative Council, Salt Lake City, Air Pollution Advisory Committee. June 1962. 32 pp.

A survey was made of the available information concerning air pollution problems in Utah. No evidence was found to indicate that Utah has a major air pollution problem at this time; however, a few perisistent problems exist in restricted areas. Over the years three air pollution situations in Utah have produced injury to plant and animal life or have constituted a public nuisance. These are: (a) sulfur dioxide in Salt Lake Valley (non-ferrous smelters, burning of coal, gasoline combustion, and petroleum refining are the principal sources); (b) smoke and smog along the Wasatch Front and in other localized areas (burning of coal, open burning on municipal dump grounds and in junk yards, and waste disposal around private homes constitute the major sources); and (c) fluorides (processing of Utah ores by steel mills in Utah County, brick and ceramic plants, phosphate fertilizer plants, and general combustion processes are the principal sources. Industry has made substantial progress in alleviating sulfur dioxide, fluorides, smoke, and hydrocarbons by installing expensive control equipment and by supplementing this equipment with extensive research, survey, and monitoring programs. Legislation authorizing the state, or cities and towns, to deal with public nuisances if ound in the Utah Code. There is no definition of air pollution, however, and its treatment as a nuisance is questionalbe. Enabling legislation should define the problem, permit study of its effects, and permit actions to control injurious practices. (Author summary modified)

02653

K. F. Wentzel

FLUORINE-CONTAINING IMMISSIONS IN THE VICINITY OF BRICKWORKS. STAUB (ENGLISH TRANSLATION) 25, (3) 45-50, MAR. 1965. CFSTI TT 66-51040/3

Damage to vegetation by brickworks is widespread all over Germany It is characterized by spontaneous occurrence and particularly aggressive character, dying off very rapidly in the interior of woods and greatly varying degrees of damage. Harmful substances are HF and SiF4. Areas up to about 100 ha in extent occur. The destruction and reduction in growth there and the damages arising therefrom reach amounts at times running into five figures of German marks. Three causes of damage exhaustively investigated in recent years are reported. In two cases on the plain it was possible, by means of 50 m-high chimneys erected later , to prevent the damage over a long period. At a third, in the mountains, on the other hand, this measure increased the scale of the initial damage considerably. (Author summary)

02847

Environmental Engineering, Inc., Gainesville, Fla.

BORDEN CHEMICALS, INC. GRANULAR TRIPLE SUPERPHOSPHATE, PINEY POINT, FLORIDA. (FINAL REPORT). Office of Air Programs Contract 68-02- 0232, Rept. 73-FRT-9, 45p., Sept. 11-12, 1972. 1 ref.

Emission tests were conducted on the granular triple superphosphate process at the Borden Chemical phosphate works in Piney Point, Fla. in order to obtain data for use by both the Industrial Studies Branch and the Performance Standards Branch of the Environmental Protection Agency. Measurements were made at the outlet stack for soluble and insoluble fluorides; and grab samples of scrubbing liquids, process reactants, and process product were analyzed for fluoride and phosphorus pentoxide content. Values for water soluble fluorides in lb/ton P2O5 fed ranged from 0.04-0.10, while those for total fluorides (lb/ton P2O5 fed) had an identical range. Total fluorides in lb/hr varied from 0.5-1.2. Cyclones and scrubbers serve as control apparatus.

02988

W. Oelschlager

THE CONTAMINATION OF THE ATMOSPHERE BY FLUORINE. Staub (English Transl.) 25, (12) 5-10, Dec. 1965. CFSTI TT66-51040/12

Fluorine plays an important role among toxic air pollutants, because even a relatively small amount of it can be harmful for plants and animals. The main emitting sources of fluorine are plants producing hydrofluoric acid, aluminum, superphosphate and enamel; further, brickworks, metallurgical works and industrial plants consuming very high amounts of low quality coal. Fluorine contents of raw materials, fluorine emissions in different processes and harmful effects on plants and animals are reported. Finally, the measures to be taken to reduce fluorine emission are briefly discussed. (Author summary)

03129

Avy., A. P.

METHODS OF REDUCING POLLUTION CAUSED BY SPECIFIC INDUSTRIES. (CHAPTER VI. CHEMICAL INDUSTRY). European Conf. of Air Pollution, Strasburg, 1964. p. 337-356.

The pollutants discharged by the chemical industry may be subdivided into several classes. The first and most important class is that of harmful products emitted in large quantities by the 'heavy' chemical industry and, in particular, organic chemical works: Sulphur dioxide, sulphuric acid, chlorine, whether manufactured or in the form of impurities in the basic material: fluorine in the case of fertilizers and fluorine again in aluminum electro-chemistry. The chemical industry has a wide range of special problems which is in a constant state of flux owing to the wide and ever-increasing variety of new synthetic products (intermediate and finished) in the organic chemical industry. From the technical point of view, the prevention of pollution by such products depends on their presentation and manner of application. A problem directly connected with chemical manufacture is that of smell: mercaptans, hydrogen phosphide, methylamines, etc., although, of course, it does not arise in the chemical industry alone. Technical methods used to reduce pollution are highly develpped for dusts and smoke and there is a wide choice of apparatus. The chemical industry, like all others, is subject to laws and regulations governing industrial air pollution. A fairly sharp distinction, however, should be drawn between laws, which lay down in general terms the objects to be attained and the obligations to be fulfilled, and the regulations which embody detailes of the limits imposed and the degree of reduction demanded. In this last report, caution is necessary and impossible or unnecessary standards should not be set. It is clear that international liaison or even international collaboration is not only desirable, but necessary.

03450

C. I. Harding, B. B. McKee, and J. J. Schueneman

FLORIDA'S AIR RESOURCES. Florida State Board of Health, Jacksonville. Feb. 1961. 66 pp.

The purpose of this survey is to describe the State's characteristics as they relate to air resources, review present control activities, assess the present and potential status of air pollution. The survey accumulated reports of air pollution problems due to 265 particular sources of pollution. The most serious problem is due to 18 phosphate rock processing plants which are responsible for emission of gaseous and particulate fluorides and other dusts. Nine pulp mills which emit odorous materials and particulate matter are another major problem. Other problems including automobile exhausts have also been reported. The State of Florida first took official notice of its air pollution problems in 1955 when Chapter 381 Florida Statutes was amended giving the State Board of Health authority to promulgate rules and regulations for the control of air pollution. On the basiss of information developed in this survey recommendations have been made in the interest of protecting and restoring the air resources of the State of Florida.

03565

Environmental Engineering, Inc., Gainesville, Fla.

BORDEN CHEMICALS, INC. DIAMMONIUM PHOSPHATE, PINEY POINT, FLORIDA. (FINAL REPORT). Office of Air Programs Contract 68-02-0232, Rept. 73-FRT-13, 62p., Sept. 26/27, 1972. 3 refs.

An Office of Air Programs source emission test conducted by Environmental Engineering, Inc. is reported for the Borden Chemical phosphate works in Piney Point, Florida. Measurements were made for soluble and insoluble fluorides at the scrubber outlet to the atmosphere; and grab samples of the scrubbing liquids, the process reactants, and the process product were analyzed for fluoride and phosphorus pentoxide content. Total fluoride in mg ranged from 3.6-5.2, while total fluoride in gr/SCF was 0.0008. Water soluble fluoride in lb/hr ranged from 0.54-0.66, and total fluoride in lb/ton P205 Fed was 0.03. Total fluoride in gr/CF stk. cond. was 0.0007. This data will be used to establish performance standards.

04068

M. B. Belaga and P. N. Maistruk

EXPERIMENTAL SANITARY IMPROVEMENT OF WORKING CONDITION IN THE YA. M. SERDLOV SUPERPHOSPHATE PLANT. Gigiena i Sanit. 28 (1), 80-2 (Jan. 1963). Russ. (Tr.) (Translated by B. S. Levine in U.S.S.R. Literature on Air Pollution and Related Occupational Diseases, Vol. 12.)

The most significant sanitary measures instituted in the phosphate plant's basic production departments to improve sanitary working conditions are the following: The apatite unloading from the railroad gondolas and loading onto small delivery cars was changed from manual to electric crane shovels or buckets, which lowered the stockyard air dust density by 80 - 90%. Manual cleaning of the bunker grates, from which the apatite was picked up by the elevator, was replaced

by automatically operated electric scrapers, which also lowered the air dust density by 80 - 90%. The acid diluting, dosing, and temperature regulating in the operating section had been automated, the conduits made leakproof, and the exhaust ventilation was operated at 30 mm of mercury or below; all this lowered the department's air dust density to 17 - 12% of the original. At the silico-fluoride department, the use of coal for drying-oven heating was replaced by natural gas, and the oven had been heat insulated, which eliminated the presence of coal dust in the air and lowered the intensity of heat radiation by the drying ovens from 0.5 to 0.2 cal/sq cm.min.At the department of granulated superphosphate, the following improvements have been instituted: natural gas instead of coal is burned in heating the drying drums, a two-step air purification from fluorine and superphosphate dust has been installed, all ventilation conduits have been examined and made absolutely leak-proof, etc. The tail gases discharged into the atmosphere now contain only 0.18 g/cu m of dust and 0.002 g/cu m of fluorine. In conclusion, study of the plant's personnel medical and work records indicated that due to the above described system of sanitary, therapeutic, general medical and prophylactic services the rate of morbidity and loss in work days have been steadily declining in this plant.

05040

Environmental Engineering, Inc., Gainesville, Fla.

BORDEN CHEMICAL, INC. DIAMMONIUM PHOSPHATE, PINEY POINT, FLORIDA. (FINAL REPORT). Office of Air Programs Contract CPA-70-82, Rept. 72-CI-3, 126p., Jan. 19-20, 1972. 1 ref.

Emission tests were conducted at the Borden Chemical diammonium phosphate plant located in Piney Point, Fla. in order to obtain data for the use of both the Industrial Studies Branch and the Performance Standards Branch of the Environmental Protection Agency. Measurements were made for both total fluorides and ammonia in the inlet and outlet ducts of the reactor and dryer scrubbers, the inlet duct of the cooler scrubber, and the common outlet stack to the atmosphere. Grab samples of the scrubbing liquids, the process reactants, and the process product were taken and analyzed for fluoride and phosphorus pentoxide content. Total fluorides at the Station U outlet ranged from 0.0006-0.0012 gr/SCF, while those at the reactor tail gas scrubber outlet (Station J) varied between 0.0018-0.0043 gr/SCF. The dryer tail gas scrubber outlet for Station L showed a total fluoride concentration of 0.0014-0.0083 gr/SCF. Ammonia concentrations at the Station U common outlet varied between 0.0001 and 0.0002 gr/SCF, and the reactor tail gas scrubber outlet (Station J) had an ammonia output of 0.002-0.005 gr/SCF. The Station L dryer tail gas scrubber outlet registered 0.001-0.002 gr/SCF NH3.

05090

A. J. Teller

CONTROL OF GASEOUS FLUORIDE EMISSIONS. Chem. Eng. Progr. 63, (3) 75-9, Mar. 1967.

Emission factors for fertilizer manufacture and for aluminum manufacture are presented. The primary design problems of recovery systems are stated. The pressure drop requirement, transfer unit requirements, effluents from phosphoric acid production, some scrubbing systems, design criteria, and hybrid systems are considered. efluents from phosphoric acid production, some scrubbing systems, design criteria, and hybrid systems are considered.

05139

Pfaff, Roger O.

KAISER AGRICULTURAL CHEMICALS, INC., REIGELWOOD, NORTH CAROLINA. Office of Air Quality Planning and Standards, Research Triangle Park, N. C., Emission Measurement Branch and Weston (Roy F.), Inc., Office of Air Quality Planning and Standards Contract, Rept. 73-FRT-16, 19p., 1973. 1 ref.

Emission measurements for phosphorous pentoxide, particulates, fluoride, and ammonia were performed at the inlet and outlet of a granulator scrubber situated in the granulated NPK fertilizer plant at Kaiser Agricultural Chemicals in Reigelwood, North Carolina. All inlet tests were run simultaneously with the corresponding outlet tests, and P2O5 analyses were obtained from the fluoride test runs. Ammonia tests were run within the same time period as the fluoride tests. Total particulate concentrations at the outlet ranged from 0.03735-0.1309 gr/DSCF and from 0.09494-0.31164 gr/DSCF at the inlet. Particulates for the probe, cyclone, and filter catch ranged from 0.00874- 0.1119 gr/DSCF at the outlet and from 0.04255-0.21106 gr/DSCF at the inlet. Ammonia concentrations were 0.00202 gr/DSCF at the inlet and 0.00116 gr/DSCF at the outlet. Total fluorides measured 0.00076 and 0.00055 gr/DSCF at the inlet and outlet, respectively. Total P2O5 for the inlet was 0.00153 gr/DSCF, while the outlet concentration measured 0.00023 gr/DSCF. This data will be used to establish performance standards.

05140

Pfaff, Roger O.

SWIFT AGRICULTURAL CHEMICALS, INC., BIRMINGHAM, ALABAMA. Environmental Engineering, Inc., Gainesville, Fla., Office of Air Quality Planning and Standards Contract, Rept. 73-FRT-6, 22p., 1973. 1 ref.

Emission measurements of phosphorus pentoxide, fluorides, particulates, and ammonia were performed at the outlet of the control system for the granulated NPK fertilizer plant at Swift Agricultural Chemicals in Birmingham, Alabama. Total particulates ranged from 0.04943-0.10764 gr/DSCF; while those for the probe, cyclone, and filter catch were between 0.02105 and 0.08459. Ammonia concentration at the outlet ranged from 0.00034-0.00050 gr/DSCF, and total fluorides varied from 0.00056- 0.00101 gr/DSCF. Values for total P2O5 fell between 0.00053 and 0.01065 gr/DSCF. Data will be used for establishing performance standards. Control equipment includes cyclones and scrubbers.

05587

Environmental Engineering, Inc., Gainesville, Fla.

BORDEN CHEMICAL, INC. GRANULAR TRIPLE SUPERPHOSPHATE. (FINAL REPORT). Office of Air Programs Contract CPA 70-82, Rept. 72-CI- 5A, 124p., Jan. 25-26, 1972. 1 ref.

Emission test runs were performed on the granular triple superphosphate process at the Borden Chemical phosphate works located in Piney Point, Florida in order to obtain data for use by both the Industrial Studies Branch and the Performance Standards Branch of the Environmental Protection Agency. Total fluorides were measured at the outlet stack, and additonal measurements were made in the inlet ducts of the reactor and dryer and the cooler tail gas scrubbers. The outlet ducts of the reactor and dryer tail gas scrubbers were also tested. A bypass stream between the dryer tail gas scrubber and the reactor tail gas scrubber was also measured for fluorides. Total fluorides in lb/hr ranged from 1.07-2.19 for the

reactor tail gas scrubber inlet, 0.1455- 0.2254 for the reactor scrubber outlet, 11.19-53.44 for the dryer tail gas scrubber inlet, 1.39-2.45 for the dryer scrubber outlet, 3.08-5.50 for the cooler tail gas inlet, 1.06-2.83 for the outlet of Station U, and 990-3217 for the bypass at Station W.

05601

R. R. Ott and R. E. Hatchard

CONTROL OF FLUORIDE EMISSIONS AT HARVEY ALUMINUM, INC. - SODERBERG PROCESS ALUMINUM REDUCTION MILL. J. Air Pollution Control Assoc 13 (9) 437-43, Sept. 1963. (Presented at the 29th Annual Meeting, Northwest Pollution Control Association, Salen, Ore., Oct. 24-27, 1962.)

A 300 Soderberg, vertical-stud type aluminum mill, located just north of the municipal boundaries of The Dalles, Ore., began production in July 1958. Multiclone type dust collectors and scrubber towers were provided as part of the initial mill installation. Tests have shown that the fluoride removal efficiencies of the scrubbers are 95% or higher if satisfactory maintenance and operation are provided. In response to complaints filed by a private party in 1959 and by agricultural interests in The Dalles area in the spring of 1960, the Sanitary Authority intensified the area, mill, complaint, and air sample surveys and evaluations. Horticultural damage from fluorides has been shown to occur in certian foliage and fruit grown in The Dalles area. Research investigations by the Oregon State University's Agricultural Experiment Station are continuing and include a proposed project for the evaluation of any effect of fluorides upon sweet cherry crop production. The emissions from individual reduction cells, which by-pass the vacuum collection ducts to the control system, have been a suspected source of fluoride discharges that were contributing to the horticultural damage. These emissions originate at the cells during several operational steps including inadequate maintenance of the cell. Roff monitor fluoride sample data obtained in 1961 led to a pilot project including an evaluation of fluoride removal efficiencies. The Authority has granted conditional approval for the roof monitor control system subject to its operation at a maximum fluoride removal efficiency. The five cell building roof monitor systems were completed in September 1962. These controls include an arrangement of spray nozzles for wetting fluoride particulates, aerosols, and gases prior to impingement or absorption on poly-vinyl plastic screens - built into the cell building roof monitors. The final evaluation of the effectiveness of this fluoride removal system will depend upon its over-all reduction in the occurrence of horticultural damage in The Dalles area. (Authors' summary)

05811

Semrau, Konrad T.

EMISSION OF FLUORIDES FROM INDUSTRIAL PROCESSES--A REVIEW. J. Air Pollution Control Assoc., 7(2):92-108, Aug. 1957. 131 refs. (Presented at the American Chemical Society Annual Meeting, 130th, Atlantic City, N. J., Sept. 1956.)

The principal mechanisms of the liberation of fluorides, in high temperature processes is pyrohydrolysis, resulting in the formation of hydrogen fluoride, as indicated by thermodynamic studies and a review of the literature. The principal variables in pyrohydrolysis in most industrial processes were the equilibrium of the reaction, the water vapor concentration in the process atmosphere, and the factors determining mass transfer. Reaction rates were generally high, although little information is available. Significant formation of silicon tetrafluoride was limited to cases involving thermal decomposition of fluorosilicates or the reaction of fluorides and silica with acids at relatively low temperatures. Formation of volatile metal fluorides may be a significant liberation mechanism in some cases, although it is generally of less importance than pyrohydrolysis.

05871

Semrau, Konrad T.

EMISSION OF FLUORIDES FROM INDUSTRIAL PROCESSES - A REVIEW. Preprint, American Chemical Society, Washington, D. C., 17p., 1956. 134 refs. (Presented at the American Chemical Society, Meeting, 130th, Atlantic City, N. J., Sept. 1956.)

A review of industrial sources of gaseous and particulate fluorine emissions is presented along with the mechanisms involved in fluorine liberation. The principal mechanism of fluorine liberation in high temperature processes is pyrohydrolysis, which results in the formation of hydrogen fluoride. Variables affecting the formation of hydrogen fluoride include the equilibrium of the reaction, the water vapor concentration in the process atmosphere, and the factors determining mass transfer. Significant formation of silicon tetrafluoride appears to be limited to cases involving thermal decomposition of fluosilicates or the reaction of fluorides and silica with acids at relatively low temperatures. The formation of volatile metal fluorides may be a significant mechanism of liberation in some cases but is generally of less importance than pyrohydrolysis. Fluorine emissions in terms of the percent of fluorine input are tabulated for the following industrial processes: calcining ironstone, steelmaking, brick making, glass making, roasting zinc oxide fume, calcining topaz, calcium metaphosphate manufacture, and the defluorination or manufacture of superphosphate. The table can be used to make order of magnitude estimates of the probable fluorine emissions from a given process. (Author summary modified)

06241

P. Macuch, G. Balazova, L. Bartosova, E. Hluchan, J. Ambrus, J. Janovicova, and V. Kirilcukova

HYGIENIC ANALYSIS OF THE INFLUENCE OF NOXIOUS FACTORS ON THE ENVIRONMENT AND STATE OF HEALTH OF THE POPULATION IN THE VICINITY OF AN ALUMINIUM PLANT. J. Hyg. Epidemiol. Microbiol. Immunol. (Prague) 7, 389-403 (1963).

The state of health of all children aged 6-14 years living for at least six years in the fall-out area of the aluminum works was studied. Special attention was paid in their history and in objective examination to the signs described in the literature as the manifestations of the action of fluorine compounds on the human organism, i.e. the haemoglobin percentage, the erythrocyte and leucocyte count and the differential white cell count. Fluoride excretion was controlled in a single urine sample collected over a period of four hours. Bone radiograms were made of the lumbar spine, together with the hip joint, and of the shoulder and arm, together with the elbow. In all the children the teeth were also examined. The average haemoglobin values among children in the given age group (6-14 years) in the fall-out area of the aluminium plant were significantly lower than in the controls. Average erythrocyte values were significantly higher. Average leucocyte values in children aged 6-8 in the fall-out area were higher than in the controls. In the higher age groups the situation was reversed. In the differential white cell count no significant differences were found between average granulocyte values. The significant difference between the amount of haemoglobin in children in the fall-out area of the aluminium plant and in the control group shows

that the lower haemoglobin findings in the affected community could be attributed to the less favourable environmental conditions resulting from its proximity to the aluminium plant. The experiences and the individual results obtained from these analyses are used as a basis for suggestions for essential health measures in concrete situations and for the formulation of principles of preventive hygienic protection when projecting and selecting the site of large industrial plants.

06371

S. G. Luxon

ATMOSPHERIC FLUORIDE CONTAMINATION IN THE POTTERY INDUSTRY. Ann. Occupational Hyg. (London), 6 (3), 127-30 (July 1963) (Presented at a Scientific Meeting, British Occupational Hygiene Society, Jan. 4, 1963.)

Investigations were carried out during a health survey in the pottery industry with the object of determining the nature and amount of the fluorine compounds liberated during the firing of ware in muffle type kilns at temperatures in the region of 1150 deg C. Gas samples were taken using sintered plate gas scrubbers which were known to be almost 100% efficient against acid gases. The amount of fluoride trapped in the second scrubber was of the order of 50% of that trapped in the first, and repeatable results could not be obtained. Thus, effective absorption was not being achieved. These results, together with the incongruous etching pointed towards the presence of some agent other than hydrofluoric acid. Thermal precipitator samples showed that the air of the kiln room contained particles having a median size of 0.1 micron, almost all particles being less than 0.4 micron. Samples taken from the dust collecting on ledges of doors of the kilns and on beams in the workrooms were examined by X/ray analysis and were found to contain substantial quantities of ammonium fluosilicate. Having established the nature of the atmospheric contaminant, efforts were next directed toward a method of trapping the sub-micron particles while retaining a sufficient air-flow to enable large samples to be taken so ensuring reliable estimations down to less than one part per million. The method used showed that over 99% of the fluoride present was trapped by this method. Samples were taken at numerous positions in the kiln workrooms and in every case the highest figures were associated with the higher kiln through-puts. Various ventilation control methods are discussed. A better method of dealing with the problem would be to use materials in the body containing little or no F. The hazard from fluorides is not considered to be serious if relatively simple precautions are taken. The etching of the glass in the kiln room, surrounding rooms and buildings cannot necessarily be taken as indicative of the concentration present in the air. External effects due to the emission of fluosilicates will follow the general pattern associated with particulate clouds.

07650

Otlowski, George J., Louis Farkas, George Boyd, and Joseph Hynes

TAKE A DEEP DEADLY BREATH. Middlesex County Dept. of Public Welfare, New Brunswick, N. J., Board of Chosen Freeholders, 35p., ((1967)). (110 refs.)

A proposal was made to construct an aluminum reduction plant in the Raritan Bay area in New Jersey. In an effort to prevent the location of the plant in this area, a report is presented describing the air and water pollution deriving from this industry. The aluminum reduction process is described and sulfur dioxide and fluorides are cited as being major effluents from the process. The health hazards associated with these two pollutants are discussed, and several law suits are mentioned which were brought against various aluminum companies for damages sustained by plants, animals, and humans attributed to emissions from the companies. It is concluded that the Raritan Bay area, which already has an air pollution problem, cannot tolerate the additional burden that the aluminum reduction plant would impose on the atmosphere.

08102

Office of Air Programs, Research Triangle Park, N. C., Emission Testing Branch

ALCOA ALUMINUM. BADIN, NORTH CAROLINA. (FINAL REPORT). Rept. 72-MM-12, 135p., 1972. 1 ref.

Results are presented from an Office of Air Programs emissions test conducted at Alcoa Aluminum in Badin, North Carolina. The plant was considered a well-controlled stationary source in the aluminum reduction industry. Three particulate runs were made at the inlet and outlet of aluminum reduction control system (hood, fluidized bed, and baghouse). The probe, cyclone, and filter catch for this method ranged from 48.49 lbs/ton feed to 60.27 lbs/ton feed at the inlet and from 0.330-0.765 lbs/ton feed at the outlet. The total particulate catch ranged from 63.83 lbs/ton feed to 83.23 lbs/ton feed at the inlet and from 5.04-6.80 lbs/ton feed at the outlet. The standard Environmental Protection Agency method was used at the outlet only. The probe, cyclone, and filter catch ranged from 0.236-0.264 lbs/ton feed, while the total catch ranged from 2.22-2.30 lbs/ton feed. The standard EPA train was also used for three runs at the inlet and outlet for fluorides. Soluble fluorides at the inlet ranged from 48.20-58.50 lbs/ton feed, while total fluoride catch ranged from 56.20-65.90 lbs/ton feed. The soluble fluoride catch at the outlet ranged from 0.099-0.520 lbs/ton feed, while the total fluoride catch ranged from 0.327-1.656 lbs/ton feed. Soluble fluorides at the roof monitor as measured by the standard EPA train ranged from 0.734-1.334 lbs/ton feed, while the total fluoride catch ranged from 85.18- 90.42 lbs/ton feed. Other methods employing a non-heated filter between the last impinger and the silica gel or a viton tube for connecting the probe to the standard sample box were also utilized for fluoride measurements at the aluminum reduction control system.

08116

Rom, Jerome J. and John M. Reynolds

TEXAS GULF SULPHUR COMPANY WET PROCESS PHOSPHORIC ACID PLANT, AURORA, NORTH CAROLINA. Environmental Engineering, Inc., Gainesville, Fla., Environmental Protection Agency Contract, Rept. 71-CI-31, 35p., Nov. 17-18, 1971.

Emission tests were conducted by Environmental Engineering, Inc. under the direction of the Environmental Protection Agency at the Texas Gulf Sulphur Company wet process phosphoric acid plant in order to obtain data for use by the Industrial Studies Branch and the Standards Development Implementation Division. Measurements were made in the outlet stack (following scrubbers) for total fluorides, while observations of visible emissions were made by a member of the Industrial Studies Branch. Fluoride emissions ranged from 0.0034-0.0016 lbs/ton P2O5 fed. One test result showed an emission rate of 0.0007 lbs of fluoride/ ton phosphorus pentoxide fed which was unrealistically low and hence should be voided. Visible emissions were 0%. (Author summary modified)

08486

Marchenko, E. N.

FUNDAMENTAL PROBLEMS OF INDUSTRIAL HYGIENE IN PROCESSING OF POLYFLUORETHYLENE RESINS. ((Osnovnye voprosy gigieny truda pri pererabotke ftoroplastov.)) Text in Russian. Gigiena Truda i Prof. Zabolevaniya (Moscow), 10(11):12-18, Nov. 1966. 9 refs.

A literature survey is presented on processes involved in the degradation of polyfluoroethylene resins. Studies of operating conditions during heat treatment of polyfluoroethylene showed that the atmosphere may be polluted with perfluoroisobutylene, tetrafluoroethylene, oxyfluorides, hydrogen fluoride, carbon monoxide, and polymer aerosols. A system of prophylactic measures has been developed which drastically reduces toxic air pollution. Heat processing of polyfluoroethylene resins requires the special attention of hygienists and engineers.

08748

Bell, Doug D.

EMISSIONS FROM ANODE BAKE PLANT AT REVERE COPPER AND BRASS, INC., SCOTTSBORO, ALABAMA. (FINAL REPORT). Environmental Protection Agency, Research Triangle Park, N. C., Emission Testing Branch, Office of Air Programs, Rept. 72-MM-24, 56p., 1972 (?). 2 refs.

A final report is presented on emission tests by the Office of Air Programs on the anode bake plant of Revere Copper and Brass, Inc. in Scottsboro, Alabama. Pollutants sampled were fluorides, particulates, hydrocarbons, and sulfur dioxide. Total fluoride emissions ranged from 0.35-0.48 lb/ton, and soluble fluoride ranged from 0.32-0.44 lb/ton. Particulates on and in front of the filter ranged from 0.36-0.41 lb/ton, while total particulate ranged from 0.70-0.87 lb/ton. Results were expressed as pounds of pollutant emitted per ton of aluminum produced. This data will be used to establish performance standards for the aluminum reduction industry. Fans and electrostatic precipitators are used. (Author summary modified)

08816

Rose, Gerhard

WILL TRASH REMOVAL BE A MARKETING FACTOR FOR THE GLASS CONTAINER INDUSTRY AND PRODUCERS OF OTHER PACKAGING MATERIAL? ((Wird die Abfallbeseitigung zu einem Marktfaktor fur die Verpackungsglas- industrie und die Hersteller anderer Verpackungsmittel? Text in German. Glastech. Ber., 40(11):438-438, Nov. 1967.

While the removal of discarded glass containers presents a pro- blem, it is not insurmountable, particularly if refuse crushing plants and techniques are developed which will refuse the silicon from waste glass. The substitution of plastic packaging materials for glass has the disadvantage that during incineration of poly- vinyl-chloride-containing material, corrosive gases are evolved, which cause severe damage to the boiler units of the incinerator plant. Furthermore, the emission of hydrochloric and hydrofluoric acids from these plastics causes dangerous air pollution to such an extent, that in the United States the incineration of plastic waste is forbidden in the vicinity of large cities.

08882

Katz, Morris

NATURE AND SOURCES OF AIR POLLUTION. Preprint, 39p., 1966. 24 refs. (Presented at the National Conference on Pollution and Our Environment, Montreal, Quebec, Oct. 31-Nov. 4, 1966, Paper A2-2.

The nature and properties of pollutants are discussed, including major sources and projected future trends. Seasonal variation in the deposition of total solids, the formation of aerosols by condensation and dispersion, the collection of aerosols and particulate matter, and atmospheric concentrations of suspended particulate matter are discussed. Properties of light scattering and optical absorbance of aerosols are cited. Condensation nuclei and ions are discussed, as well as the major chemical components of particulate pollution. Sulfur dioxide, hydrogen sulfide, organic sulfides, hydrogen fluoride and other halides, oxides of nitrogen, ozone and oxidants, carbon monoxide, aldehydes, and other organic vapor contaminants are considered. The photochemical theory of smog formation is discussed, and motor vehicle operation and emissions are considered. Dust fall and concentrations of suspended particulates, smoke, and selected pollutants in the urban atmospheres of several Canadian and United States cities are tabulated and correlated with respect to seasons and meteorological parameters.

09214

Gerstle, Richard W.

DICALCIUM PHOSPHATE BORDEN CHEMICAL COMPANY, PLANT CITY, FLORIDA. PEDCo-Environmental Specialists, Inc., Cincinnati, Ohio, Environmental Protection Agency Contract 68-02-0237, Task 1, Rept. 72-CI-15, 37p., Feb. 1972. 1 ref.

Stack emission tests were conducted, and related process samples were taken at the Borden Chemical Co. s phosphate animal feed plant in Plant City, Fla. during the period Feb. 22-25, 1972. Stack gas samples were taken in the duct leaving the kiln (before the cyclones) and in the stack after the scrubber. Three simultaneous sets of samples were taken at these sites to determine the total fluoride content of the gas streams. Moisture, carbon dioxide, and oxygen content of the gas streams were also measured; velocity, temperature, and total gas flow were determined for each test. Samples of phosphate rock feed, limestone, phosphoric acid, product and scrubber water were also taken during each run. Each stack gas sample on the dicalcium process extended over a 2-hour period. A complete summary of stack gas conditions and emission levels for each test run are tabulated.

09321

Gerstle, Richard W.

FARMLAND INDUSTRIES INC. WET PROCESS PHOSPHORIC ACID, PIERCE, FLORIDA. PEDCo-Environmental Specialists, Inc., Cincinnati, Ohio, Environmental Protection Agency Contract 68-02-0237, Task 2, Rept. 72-CI-17, 39p., March 1972.

Stack emission tests were conducted and related process samples were taken during the period March 1 and 2, 1972 at the Farmland Industries phosphoric acid plant in Pierce, Fla. Three tests were made to determine total fluoride emissions entering the atmosphere from the phosphoric acid manufacturing process after a primary and secondary scrubbing system. Stack gas samples were taken in the duct after the scrubber. Three sets of samples were taken to determine the total fluoride content of the gas stream. Moisture, carbon dioxide, and oxygen content of the gas stream were also measured; velocity, temperature, and total gas flow were determined for each test. Samples of feed materials, the phosphoric acid product, and scrubber water were also taken during each run. Each stack gas sample extended over a 2-hour period except for the last test which was cut short because of a process malfunction.

09332

Gerstle, Richard W.

INTERNATIONAL MINERALS AND CHEMICALS SUPER PHOSPHORIC ACID, BARTOW, FLORIDA. PEDCo.-Environmental Specialists, Inc., Cincinnati, Ohio, Environmental Protection Agency Contract 68-02-0237, Task 2, Rept. 72-CI-16, 54p., March 1972.

Stack emission tests were conducted, and related process samples were taken during the period Feb. 28-March 1, 1972, at the International Mineral and Chemical Co. superphosphoric acid plant in Bartow, Fla. Three tests were made to determine total fluoride emissions before and after the scrubber serving the superphosphoric acid plant. Fumes from the plant acid recycle tank, and the vent serving the product storage tank and barometric seal tank are directed into a combination venturi scrubber and packed bed scrubber in series before entering the atmosphere. Samples were taken simultaneously in the two lines entering the scrubber system, and in the single duct leaving the scrubber. The equipment layout and the locations of the sampling sites are included. Three sets of samples were taken to determine the total fluoride content of the gas streams. Moisture, carbon dioxide, and oxygen contents of the gas streams were also measured; velocity, temperature, and total gas flow were determined for each test. Samples of feed, product, and recycled acid were taken during each run, as well as scrubber water samples.

09541

Sprung, S., and H. M. V. Seebach

FLUORINE BALANCE AND FLUORINE EMISSION FROM CEMENT KILNS. ((Flu- orhaushalt und Fluoremission von Zementofen.)) Text in German. Zement-Kalk-Gips (Wiesbaden), 21(1):18, Jan. 1968. 20 refs

In the burning of Portland cement clinker, fluorine is partly driven out of the raw materials and fuel. To determine whether gaseous fluorine is emitted along with the other kiln gases, complete fluorine determinations were performed for 11 cement kilns of varying design. No gaseous fluorides could be detected in the cleaned gas from these kilns; the significance of electrofilters in the removal of solid fluorides is discussed. In conclusion, cement kilns cannot emit gaseous fluorides because, in the presence of an excess of CaO, they produce CaF2. The negligible level of fluorides in the dust from the cleaned gas (0.009-1.420 mg. F/Nm to 3rd power) is thus not dependent upon the magnitude of the fluorine balance, but upon the efficiency of the electrostatic precipitators. The amount of fluorine combined in the clinker ranges from 88-98 percent of the total fluorine intake, and this percentage increases with a decrease in dust load of the emitted gas. Fluorine appears as CaF2 in clinker and kiln dust and, as such, is harmless since CaF2 is relatively insoluble in water.

09651

Gerstle, Richard W. and Robert S. Amick

EMISSION TESTING REPORT. STAUFFER CHEMICAL COMPANY, TARPON SPRINGS, FLORIDA. (FINAL REPORT). PEDCo-Environmental Specialists, Inc., Cincinnati, Ohio, Office of Air Quality and Planning Contract 68-02-0237, Task 4, Rept. 72-MM-05, 51p., 1972. 1 ref.

Atmospheric emissions of fluorides, phosphorus pentoxide (P2O5), total particulates, and sulfur dioxide from Stauffer Chemical Company s elemental phosphorus plant at Tarpon Springs, Florida were sampled to form a data base for New Source Performance Standards. Tests were made to determine fluoride and P2O5 concentrations before and after the venturi scrubber serving a furnace slag tapping operation. Fluoride, P2O5, total particulates, and sulfur dioxide concentrations were also measured before and after the spray chamber serving the feed nodulizing kiln. Additionally, the fluoride and P2O5 concentrations in the air return line and the carbon monoxide line leading to the kiln were measured. Composite stack gas total fluoride emissions were equal to 0.0262 gr/DSCF, while the total P2O5 emissions from the same source were between 0.264 and 0.408 gr/DSCF. Composite values for emissions from the nodulizing kiln-scrubber spray chamber outlet C were 0.00660 gr/DSCF for total fluorides and 0.0150 for total P2O5; those for chamber outlet B were, respectively, 0.00656 and 0.0185 gr/DSCF. The total particulate catch (weighted average) for the nodulizing kiln- scrubber spray chamber outlet was 0.0993 gr/DSCF. Sulfur dioxide emissions at the spray chamber outlet ranged from 144-415 ppm. Orsat analyses were also performed.

09690

Spruiell, Stanley

INTERNATIONAL MINERALS AND CHEMICALS, AMERICUS, GEORGIA. Office of Air Quality Planning and Standards, Research Triangle Park, N. C., Emission Testing Branch, Rept. 73-FRT-15, 34p., 1973. 1 ref.

Emission tests were performed at the International Minerals and Chemicals plant in Americus, Georgia for the purpose of setting standards for phosphate fertilizer plants. The normal superphosphate plant was tested for particulates and fluorides, while the ammoniator-granulator plant was tested for ammonia, particulates, and fluorides. Values were recorded for both inlet and outlet scrubber concentrations. Total particulates for the superphosphate plant ranged from 0.0965-0.1726 gr/DSCF at the outlet, while the concentrations at the ammoniator scrubber outlet ranged from 0.01304-0.02339 gr/DSCF. Total fluorides at the outlets ranged from 0.0527-0.120 gr/DSCF and from 0.000201- 0.000543 gr/DSCF at the superphosphate and ammoniator plants, respectively. Ammonia concentrations at the ammoniator scrubber outlet varied between 0.912 and 1.49 gr/DSCF.

09692

Kulujian, Norman and Richard W. Gerstle

FMC CORPORATION, POCATELLO, IDAHO. PEDCo-Environmental Specialists, Cincinnati, Ohio, Office of Air Programs Contract 68-02-0237, Task 15, Rept. 72-MM-26, 26p., 1972. 1 ref.

Emission tests were conducted before and after the No. 1 scrubber serving the No. 2 calcining kiln at the FMC Corporation plant in Pocatello, Idaho which was designated as a well-controlled stationary source in the elemental phosphorus reduction industry. Samples were collected to determine the filterable and total particulate emissions, fluorides, phosphorus pentoxide (P2O5), and nitrogen oxides at each sampling location. Particulates (probe, cyclone, and filter catch) ranged from 0.0478-0.162 gr/DSCF at the outlet and from 0.183-0.873 gr/DSCF at the inlet. Total catch at the outlet was 0.141-0.285 gr/DSCF. Total fluorides at the outlet ranged from 0.00187-0.00893 gr/DSCF and from 0.03328-0.1576 gr/DSCF at the inlet. Total average P2O5 was .00647 gr/DSCF at the outlet and .0372 gr/DSCF at the inlet. The average outlet emission of NOx was 155 lbs/hr, while that for the inlet was 142 lbs/hr.

09693

Amick, Robert S. and Richard W. Gerstle

MONSANTO CHEMICAL COMPANY, SODA SPRINGS, IDAHO. PEDCo- Environmental Specialists, Inc., Cincinnati,

Ohio, Office of Air Programs Contract 68-02-0237, Task 15, Rept. 72[MM-27, 35p., 1972. 1 ref.

A series of emission tests were conducted at the elemental phosphorus plant of Monsanto Chemical Company in Soda Springs, Idaho. Fluoride, phosphorus pentoxide (P2O5), sulfur trioxide, and sulfur dioxide concentrations before and after the venturi scrubber serving the slag tapping operation of the No. 8 electric furnace were measured. Average emission results for the fluoride tests in lb/hr fluoride were .21 at the outlet and 2.1 at the inlet, indicating and efficiency of 90.0%. The P2O5 emission rate was .00610 lb/hr at the outlet and .11195 lb/hr at the inlet for an efficiency of 94.8%. Average emission results for the P2O5 tests were .00771 lb/hr of P2O5 at the outlet and .08784 lb/hr P2O5 at the inlet (efficiency of 90.4%). Fluorides measured .00124 lb/hr at the outlet and .01807 lb/hr at the inlet (efficiency of 92.0%). Sulfur trioxide outlet and inlet concentrations, respectively, were: 2.5 and 74 ppm (efficiency of 96.6%). Sulfur dioxide removal showed an efficiency of 29.6% with an outlet concentration of 3.8 ppm and an inlet concentration of 5.4 ppm. These data will be used to set performance standards.

09694

Kulujian, Norman and Richard W. Gerstle

INTERNATIONAL MINERALS AND CHEMICAL CORP., KINGSFORD, FLORIDA. PEDCo-Environmental, Cincinnati, Ohio, Office of Air Programs Contract 68-02-0237, Task 12, Rept. 73-ROC-1, 28p., Feb. 1973. 1 ref.

Atmospheric emissions of particulates and fluorides from the International Minerals and Chemical corporation phosphate rock dryer in Kingsford, Florida were sampled to establish a guide for New Source Performance Standards. Triplicate tests were performed to determine particulate and fluoride concentrations at the inlet and outlet of the dryer scrubber. Total particulate concentrations in lb/hr averaged out to 945.5 for the inlet and 32.51 for the outlet. Total fluoride concentration was 21.76 lbs/hr at the inlet and 2.3 lbs/hr at the outlet. Outlet flow rates for all cases except one particulate run were slightly higher than volumes sampled at the inlet. This may have been caused by cyclonic flow distribution; but, since the maximum difference was only three percent, other factors may have contributed to the variation.

09695

Bell, Carl D.

EMISSION TESTING REPORT. INTERNATIONAL MINERALS AND CHEMICALS (IMC), WINSTON-SALEM, NORTH CAROLINA. York Research Corp., Stamford, Conn., and the Office of Air Quality Planning and Standards, Research Triangle Park, N. C., Emission Testing Branch, Office of Air Quality Planning and Standards Contract, Rept. 73-FRT-14, 21p., 1973. 2 refs.

An Office of Air Quality Planning and Standards emission testing program was conducted at the International Minerals and Chemicals (IMC) plant in Winston-Salem, North Carolina, selected as a well-controlled stationary source in the phosphate fertilizer industry. Particulates, fluorides, phosphorus pentoxide (P2O5), and ammonia were sampled at the inlet to the dryer, the inlet to the cooler, and the outlet of the scrubber. Total particulate catches at the dryer inlet, cooler inlet, and scrubber outlet were: 10.6-20.9 lbs/hr (average 17.1); 8.44-17.4 lbs/hr (average 13.4); and 10.9-20.4 lbs/hr (average 15.1), respectively. Total fluoride catches for the dryer inlet, cooler inlet, and scrubber outlet were respectively: 0.06-0.34 lbs/hr (average 0.16); 0.58-1.19 lbs/hr (average 0.90); and 0.06-0.16 lbs/hr (average 0.11). Total P2O5 for the dryer inlet, cooler inlet, and scrubber outlet were respectively: 13.7-73.7 mg; 340.0-651.0 mg; and 12.7-40.4 mg. Ammonia results for the same three sampling points were respectively: less than 0.3-21.3 mg; 1.8-2.9 mg; and less than 0.3 to 13.0 mg. Results for trace metals and mercury analysis for the second fluoride run are also presented. (Author summary modified)

09696

Midwest Research Inst., Kansas City, Mo.

SOURCE TESTING REPORT. ARCO CHEMICAL COMPANY, FORT MADISON, IOWA. (FINAL REPORT). Office of Air Programs Contract 68-02-0228, Proj. 3585-C, Task 22, MRI Task 23, Rept. 73-FRT-1, 20p., 1973. 2 refs.

Fluoride and ammonia emissions were determined for the ARCO Chemical Company plant at Fort Madison, Iowa, designated by the Environmental Protection Agency as a well-controlled fertilizer plant. The fluoride caught in the cyclone ranged from 0.00-0.2 lb/hr with an average of 0.108. Fluoride per ton of P2O5 ranged from 0.0-0.0123 lb/ton with an average of 0.007. Detected fluoride was present in the soluble form for the cyclone catch for all five runs; and analysis for insoluble fluoride showed less than 0.06 mg, the lower limit of detection for the method employed. The total fluoride emitted ranged from 0.39-0.85 lb/hr with an average emission of 0.554. All ammonia analyses showed less than 0.3 mg, the lower detection limit; and there was no detectable ammonia discharged from the stack for the period. Results were also collected for moisture and Orsat analysis of the stack gases for each fluoride run. (Author summary modified)

09697

Environmental Science and Engineering, Inc., Gainesville, Fla.

SOURCE TEST REPORT ON MEASUREMENT OF EMISSIONS FROM OCCIDENTAL CHEMICAL COMPANY, WHITE SPRINGS, FLORIDA. (FINAL REPORT). Office of Air Programs Contract 68-02-0232, Task 12, Task Change 3, Rept. 73-ROC-3, 38p., 1973. 2 refs.

Fluoride and particulate emission tests were performed at the phosphate rock drying operation located at the Occidental Chemical Company, White Springs, Florida for the purpose of obtaining data for use by both the Industrial Studies Branch and the Performance Standards Branch of the Environmental Protection Agency. All emission tests were performed simultaneously at the inlet and outlet of a Dorrco Cyclonic Wet Scrubber; fluoride emissions were determined by a method currently being studied by the Environmental Protection Agency, while particulate emissions were determined by the EPA Method No. 5. Grab samples of the stack gases at each sampling site were obtained by an Orsat analyzer, and the concentrations of carbon dioxide, oxygen, and carbon monoxide were determined. Fluoride, trace metals, and mercury content in rock dryer process reactants and products were also determined. Total fluoride emissions in lbs/ton of feed ranged from 0.000596-0.000958 for the rock dryer scrubber outlet and from 0.0218-0.0269 for the inlet. Total phosphates ranged from 2.46-6.5 mg for the outlet and 236.4-347.4 mg for the inlet. Total particulate emissions in lbs/ton of feed were 0.130-0.177 for the outlet and 0.535-1.075 for the inlet.

09785

Dickinson, Janet, Robert L. Chass, and W. J. Hamming

AIR CONTAMINANTS. In: Air Pollution Engineering Manual. (Air Pollution Control District, County of Los Angeles.) John A.

Danielson (comp. and ed.), Public Health Service, Cincinnati, Ohio, National Center for Air Pollution Control, PHS-Pub-999-AP-40, p. 11-21, 1967. GPO: 806-614-30

The parameters of an air pollution problem, particularly the problem in Los Angeles County; the measures taken to eliminate the problem; and control measures still needed are described. The air contaminants include: organic gases (hydrocarbons, hydrocarbon derivatives); inorganic gases (NOx, SOx, CO); miscellaneous inorganic gases (NH3, H2S, Cl2, F2); particulates (carbon or soot particles, metallic oxides and salts, oily or tarry droplets, acid droplets, metallic fumes). Each is discussed indicating the sources and significance in the air pollution problem.

09799

Hammond, William F. and Herbert Simon

SECONDARY ALUMINUM-MELTING PROCESSES. In: Air Pollution Engineering Manual. (Air Pollution Control District, County of Los Angeles.) John A. Danielson (comp. and ed.), Public Health Service, Cincinnati, Ohio, National Center for Air Pollution Control, PHS-Pub-999-AP-40, p. 284-292, 1967. GPO: 806-614-30

The secondary aluminum melting process is described in detail indicating the type of furnaces used, charging practices, pouring practices, and fluxing. Frequently a large part of the material charged is low-grade scrap and chips. Paint, dirt, oil, grease, and other contaminants from this scrap cause large quantities of smoke and fumes to be discharged. Even if the scrap is clean, large surface to volume ratios require the use of more fluxes which can cause serious air pollution problems. The emissions from aluminum fluxing may consist of hydrogen fluoride, hydrogen chloride, chlorine in the gaseous state, aluminum chloride, magnesium chloride, aluminum fluoride, magnesium fluoride, aluminum oxide, magnesium oxide, zinc chloride, zinc oxide, calcium fluoride, calcium chloride and sodium chloride in the solid state. Because of the widely divergent properties of these air contaminants the problem of control is complicated. A canopy hood is usually used for capturing the emissions from the charging well of aluminum reverberatory furnaces. Calculation of the quantity of air required can be accomplished as shown in an example. Some type of scrubber is required to remove the soluble gaseous fraction of the effluent, and either a baghouse or an electrical precipitator is needed to control the solids. In order to maintain adequate collection efficiency, the use of high efficiency scrubbers with a caustic solution as the scrubbing medium has been found necessary. Typical test data on collection efficiency for both ordinary and high- efficiency scrubbers are outlined. Average collection efficiencies obtained on various devices on emissions from chlorinating aluminum are outlined. The devices are horizontal multipass wet cyclone, single-pass wet dynamic collector, packed-column water scrubber with limestone packing, ultrasonic agglomerator followed by a multitube dry cyclone, and an electrical precipitator. The trend in control equipment for aluminum-fluxing emissions appears to be away from electrical precipitators and toward the scrubber-baghouse combination.

10706

COMBUSTION AND THERMAL DECOMPOSITION PRODUCTS OF ORGANO-PHOSPHORUS INSECTICIDES. Preprint, Texas Univ., Austin Environmental Health Engineering Research Lab., Dept. of Civil (Env. Health) Engineering, 1968. (3) refs. (Presented at the 61st Annual Meeting of the Air Pollution Control Association, St. Paul, Minn., June 23-28, (11)p., 1968. Paper 68-9.)

Research was done on the oxidation and thermal decomposition pro- ducts of some common organophosphorus pesticides to shed light on toxic hazards resulting from fires involving pesticides, those either stored in warehouses or those freshly sprayed in fields. The data presented are mostly directed toward demonstrating how much of the organic phosphorus escapes to the air as uncoverted pesticide and how much as 'other' compounds. There are only a few reactions which would produce compounds with a toxicity com- parable to the original pesticides, while most would reduce its toxicity by a factor of 100 to 1000. (Authors' introduction, modified)

11341

York Research Corp., Stamford, Conn.

EMISSIONS FROM WATER SPRAY TOWER AND WET ELECTROSTATIC PRECIPITATOR SYSTEM AT ALUMINUM COMPANY OF AMERICA, ALCOA, TENNESSEE. Office of Air Programs Contract, Rept. 71-MM-14, York Rept. Y-7730-A, 138p., June 26, 1972. 1 ref.

The source test was performed at the Alcoa primary aluminum plant for the purpose of gathering emission data for the Performance Standards Branch and control unit efficiency data for the Industrial Studies Branch. The aluminum cells were of the vertical stud Soderberg type. Emissions from thirty cells were manifolded to a particulate knockout chamber followed by a forty foot redwood water spray tower in series with a wet electrostatic precipitator before being released to the atmosphere. The standard Environmental Protection Agency particulate train was used to sample both particulate matter and fluorides. Six simultaneous samples were taken across the control system using paper filters in three of the runs and glass fiber filters in the other three runs. In addition, three samples were taken at the outlet using membrane filters. Triplicate gaseous samples of fluorides, sulfur dioxide, and nitrogen oxides were also taken at both the inlet and outlet. Experimentation with two types of absorbing media in the midget impingers of the fluoride gas train was performed by collecting three fluoride samples in water and three in sodium hydroxide at both the inlet and outlet.

11453

AIR POLLUTION. Chambres d Agriculture, 35(304; Suppl.):1-16, Nov. 1964. 7 refs. Translated from French by Information Interscience, Inc., TR 0416.

The sources and effects of air pollution in the country and in urban communities of France are reviewed. Air pollution causes important losses of crops, contaminates the soil, vegetables and livestock, and ultimately poisons the consumers of these agricultural products. Fluorine, sulfur dioxide, and organic peroxide compounds are particularly noxious. Specific examples of damage caused by these compounds to plants and livestock in France are given. In Paris the air contains approximately 180 mineral products/cu m as well as residues of combustion, soot, ashes, dust, and wastes of all types. The principle sources of air pollution in Paris are presently due to emanations from domestic furnaces, emissions from industrial fumes, and exhaust gas from automobiles. Domestic furnaces are responsible for 70% of the sulfur pollution in the center of Paris. Anti-pollution legislation is summarized.

11541

Gerstle, Richard W.

ROCK DEFLUORINATION BORDEN CHEMICAL COMPANY, PLANT CITY, FLORIDA. PEDCo-Environmental Spe-

cialists, Inc., Cincinnati, Ohio, Environmental Protection Agency Contract 68-02-0237, Task 1, Rept. 72-CI-14, 48p., Feb. 1972. 1 ref.

Stack emission tests were conducted and related process samples were taken at the Borden Chemical Co. s phosphate animal feed plant in Plant City, Fla., Feb. 22-25, 1972. Three tests were made to determine total fluoride emissions on the rock defluorination operations. The total fluoride from the kiln exit gases at the scrubber inlet averaged 2.96 gr/SCF which is equivalent to 417.6 lb/hr. The total fluoride at the scrubber outlet averaged .0016 gr/SCF which is equivalent to .57 lb/hr. Moisture, carbon dioxide, and oxygen contents of the gas stream were also measured as well as gas velocity, temperature and total volume.

11590

Engineering-Science, Inc., Washington, D. C.

NORTHWEST BERGEN COUNTY SEWER AUTHORITY SLUDGE INCINERATOR, WALDWICK, NEW JERSEY. Office of Air Programs Contract 68-02-0225, Task 7, Rept. 72-C1-2, 133p., May 1972. 2 refs.

Source emission tests were conducted at the Northwest Bergen County Sewer Authority Sludge Incinerator to aid in the establishment of federal emission standards for new sources in this category. Three tests were conducted on the fluidized bed sludge incinerator equipped with an Impinget scrubber. Samples were taken after the scrubber for particulates, moisture, sulfur dioxide, nitrogen oxides, hydrogen chloride, mercury, and fluorides. Also sampled were carbon monoxide, carbon dioxide, and oxygen for excess air determinations. All tests were performed according to the recommended source test procedures of the Office of Air Programs, Environmental Protection Agency. Examination of the particulate loadings indicated an 80% difference between test NBS-1 (0.583 lb/hr) and either of the last two tests, 0.116 lb/hr and 0.099 lb/hr, respectively. There is no clear explanation for the reduced loadings on the second day s tests.

11876

Terracciano, Louis

EMISSION SURVEY OF THE LOWER POTOMAC SLUDGE INCINERATOR, FAIRFAX COUNTY, VIRGINIA. York Research Corp., Stamford, Conn., Air Pollution Control Office Contract, Rept. 71-CI-20, York Rept. Y-7394-I, 72p., Sept. 1, 1971.

The purpose of this program was to obtain the total emissions from the sludge incinerator. This information will be used for the establishment of Federal performance standards. Representative particulate samples were collected from the stack flue gas at the scrubber exhaust, using the Air Pollution Control Office Method. Nitrogen oxides, sulfur dioxide, hydrogen chloride, metals, mercury, and fluorides were sampled by APCO Methods. Sludge at inlet, inlet-outlet scrubber water, hydrocarbons, odors, and ash were also sampled. Scrubber outlet results are: SO2, 2.013, 2.069, and 2.125 ppm; NOx, 62.8-46.0, 83.3-75.8, and 44.3-54.7 ppm; HCl, 11.9, 6.83, and 10.9 ppm; Hg times 10 to the -6 power, .1956, .7073, and .2184 ppm; fluorides, .469; HC, 7.875-3.375-4.50, 3.375-3.375-9.0, and 2.25-3.375-7.875 ppm; odor, 80-120-5120, 40-20-640, and 160-40-20 odor units/CF; filter particulates, .0260, .0136, and .0134 gr/SCFD; and total particulates, .0335, .0221, and .0170 gr/SCFD.

11877

York Research Corp., Stamford, Conn.

EMISSIONS FOR PRIMARY ALUMINUM SMELTING PLANT (SPECIAL EMISSION CONTROL SYSTEM) AT ALUMINUM COMPANY OF AMERICA, WENATCHEE, WASHINGTON. Office of Air Programs Contract, Rept. 71-MM-16, York Rept. Y-7730-B, 104p., June 8, 1972. 1 ref.

The source tests were performed for the purpose of gathering emission data for the Performance Standards Branch and control unit efficiency data for the Industrial Studies Branch of the Environmental Protection Agency. Emissions from the primary aluminum cells were recirculated through the process via a specially developed system designed by Alcoa to improve the quality of aluminum produced and drastically reduced emissions. The standard EPA particulate train was used to sample both particulates and fluorides. Six simultaneous samples were taken across the control system using paper filters in three runs and glass fiber filters in the other three runs. Also, three outlet tests were run using membrane filters. Triplicate gaseous samples of fluorides, sulfur dioxide, and nitrogen oxides were also taken at both inlet and outlet. Experimentation with two types of absorbing media in the midget impingers of the fluoride gas train was performed by collecting three samples in water and three in sodium hydroxide. Outlet results are: particulates (lb/ton) paper filter, .365, .353, and .707; glass fiber filter, .587, .353, and .617; membrane filter, .350, .414, and .222; total fluorides (lb/ton) paper filter, .000812, .000867, and .000433; glass fiber filter, .000503, .000580, and .000509; membrane filter, .000638, .000689, and .001111; gaseous fluorides (lb/ton), .132, .300, .233, and .270; and SO2, 10.5, 7.2, 10.5, 9.3, 11.6, and 9.9 ppm.

11916

A. T. Silakova, and S. A. Mosendz

BLOOD PROTEIN AMIDE NITROGEN AND ITS POSSIBLE DIAGNOSTIC VALUE IN INTOXICATION WITH ELECTRO-WELDING AEROSOL. (Amidnii azot belkov krovi i ego vozmozhnoe diagnosticheskoe znachenie pri vozdeistvii na organizm electrosvarochnogo aerosolya.) Text in Russian. Gigien. Truda i Prof. Zabolevaniya, 12(8):56-58, Aug. 1968. 16 refs.

The aerosol obtained from automatic electro-welding, using An-60 agents, contained in mg/cu m 0.83-1.15 HF, 2-3.18 N2O5, and 120-150 dust--of which 14.4 mg/cu m was Mn, 72-90 mg/cu m Fe, 6-7.5 mg/cu m CaF, and 8.6-10.5 mg/cu m Si02. Rats placed in exposure chambers were subjected to daily 4 hr aerosol inhalations for 1, 3, 6, or 9 months. The blood from the animals was subjected to acid (1N H2SO4) hydrolysis during which ammonia derived form the blood protein amide groups was measured. The one-month aerosol inhalation reduced the amide group stability: of the total amide N, in the first 10 minutes of hydrolysis, 31% was released as ammonia in controls, as compared to 41-54% in the treated animals. Complete hydrolysis was obtained in the controls in 2 hr and in the treated animals in 30 min. These changes are believed to be caused by Mn. The hydrolysis curves show a characteristic pattern of change in the 1-month period, and stability in the 3, 6, or 9-month period. The curves may be of diagnostic value in cases of intoxication with the electro-welding aerosol.

12095

F. L. Cross, Jr. and R. W. Ross

NEW DEVELOPMENTS IN FLUORIDE EMISSIONS FROM PHOSPHATE PROCESSING PLANTS. J. Air Pollution Control Assoc., 19(1):15-17, Jan. 1969. 5 refs.

The problem of monitoring for ambient fluoride emissions near a phosphate fertilizer processing plant in Manatee County, Florida, are discussed. Results of a study conducted to determine the emission of fluorides from the surface of a gypsum settling pond at the Borden Chemical Company plant are given. Conclusions reached as a result of the study are: (1) That fluorides are emitted from such a pond at a minimum rate of about 0.16 pound per acre of surface area per day, (2) that a breakpoint of about one-half mile from the pond occurs in concentration of fluoride in the ambient air, (3) that concentrations of fluorides in excess of 75 ppm were found in young citrus leaves in groves near the gypsum pond, and (4) that, although a one-mile protective buffer zone for a phosphate plant might be considered adequate for citrus groves, it would not necessarily be adequate for row crops or ornamental flowers such as gladiolas. (Author's Abstract)

12470

York Research Corp., Stamford, Conn.

EMISSIONS FROM WET SCRUBBER SYSTEM AT REYNOLDS METALS, INC., TROUTDALE, OREGON. Office of Air Programs Contract, York Rept. Y-7730-E, OAP Rept. 71-MM-20, 148p., May 31, 1972.

A source test was performed at the Reynolds Metals Primary Aluminum Plant to gather emission data for the Performance Standards Branch and control unit efficiency data for the Industrial Studies Branch. Emissions from the cells passed through a wet scrubber system before being released to the atmosphere. The standard Environmental Protection Agency particulate train was used to sample both particulate matter and fluorides. Three simultaneous samples were taken across the control system using glass fiber filters. Triplicate gaseous samples of fluorides, sulfur dioxide, nitrogen oxides were also taken at both the inlet and outlet. Gaseous fluoride samples were collected in midget impingers using water as the scrubbing solution. Three samples were collected on the inlet and three on the outlet.

12474

York Research Corp., Stamford, Conn.

EMISSIONS FROM THE WET SCRUBBER SYSTEM AT HARVEY ALUMINUM, THE DALLES, OREGON. Office of Air Programs Contract, Emission Testing Rept. 71-MM-21, York Rept. Y-7730-F, 167p., June 7, 1972.

A source test was performed at the Harvey Primary Aluminum Plant for the purpose of gathering emission data for the Performance Standards Branch and control unit efficiency data for the Industrial Studies Branch. Emissions from the cells were manifolded to a wet scrubber system before being released to the atmosphere. The standard Environmental Protection Agency particulate train was used to sample both particulate matter and fluorides. Six simultaneous samples were taken across the control system using paper filters in three of the runs and glass fiber filters in the other three runs. In addition, three samples were taken at the outlet using membrane filters. Triplicate gaseous samples of fluorides, sulfur dioxide, and nitrogen oxides were also taken at both the inlet and outlet. Experimentation with two types of absorbing media in the midget impingers of the fluoride gas train was performed by collecting three fluoride samples in water and three in sodium hydroxide at both the inlet and the outlet. At the primary inlet, total fluorides were 42.24, 56.01, and 62.70 lbs/ton Al, gaseous fluorides were 38.59, 38.57, and 31.73 lbs/ton Al, and SO2 was 25.3, 124, and 27.5 ppm. At the primary outlet, total fluorides were 1.266, 1.666, and 1.945 lbs/ton Al, gaseous fluorides were .877, 1.418, and 1.647 lbs/ton Al, and SO2 was 107.3, 23.5, and 165 ppm. At the secondary inlet, total fluorides were .642, 2.43, and 1.89 lb/ton Al. At the secondary outlet, they were 1526, 18.34, and 1.102 lb/ton Al.

12476

Valentine, Fisher, and Tomlinson, Seattle, Washington

ATMOSPHERIC EMISSION EVALUATION, MARTIN MARIETTA ALUMINUM PRIMARY REDUCTION PLANT, THE DALLES, OREGON. Office of Air Programs Contract 68-02-0236, Rept. 73-ALR-1, 83p., Dec. 1972. 1 ref.

The exhaust gases of the primary and secondary emission control systems on the Soderburg cells at Martin Marietta Aluminum in Dalles, Oregon were sampled and evaluated Oct. 2-5, 1972 in order to set performance standards. The three samples taken from the primary outlet had a fluoride concentration of 0.000087, 0.000164, and 0.000289 grains/standard cu ft. The three samples taken from the secondary outlet had a fluoride concentration of 0.000348, 0.000168, and 0.000209 grains/standard cu ft. The standard cu ft is reported at 70 F, 1 atmosphere pressure, and dry. The following information is included: discussion of results, description of the process, location of sampling point, operation and production data on cells sampled during emission tests, and sampling and analytical procedures. Control equipment includes afterburners, bubblers, electrostatic precipitator, mist eliminator, and a spray chamber. (Author summary modified)

12548

Craste, C.

FLUORIC POISONING. X. THE JURIDICAL PROBLEM. ((L-'intoxication Fluoree. X. Le probleme juridique.)) Text in French. Rev Med Veterinaire, 104:13-20, 1953.

The problem includes (a) the proof of fluoric poisoning and (b) the estimate of damages. (a) The proof must rest on both clinical and chemical criteria. After a review of early procedures, the following factors are given as pertinent: 1. disease symptoms in an animal do not necessarily imply high fluorine content in the bones; 2. an animal must always be considered as having been a victim of fluorosis when its bone ashes contain more than 0.5% of fluorine (in CaF2); 3. when the fluorine content is less than 0.25, the subject is free from the specific poisoning; 4. between 0.25 and 0.50, the animal may show costal nodosities, and these are not incompatible with the essential osteomalacia. Tooth enamel is particularly sensitive to fluoric poisoning. Blood and muscle laboratory tests are negative. Urine tests are valueless unless supported by fluorine and fluoride tests of air and fodder. Urine tests on humans, however, may point to further useful research applicable to animals. (b) Losses due to 'factory disease' may be direct or indirect. The former include damages due to the settlement or death of the sick animals. Settlement, by mutual agreement, is subject to the positive results of the tests, and this is a source of conflict. The indemnity must cover the replacement value plus medical and other expenses. Indirect losses include cost of substitution fodder during the illness, and the loss in value of the establishment permanently exposed to fluoric pollution. Further remarks must await the outcome of instances currently before the courts.

12557

Wood, F. A.

SOURCES OF PLANT-PATHOGENIC AIR POLLUTANTS. Phytopathology, 58(8):1075-1084, Aug. 1968. 27 refs.

Sulfur dioxide, fluoride, ozone, and peroxyacetyl nitrate are currently the most important plant-pathogenic air pollutants in

the USA. These or their precursors emanate from transportation, industry, or generation of electricity. The increase in population and in our demands for energy will result in increased activity within each of these categories and attendant increases in pollutant emissions. Thus, in all instances, the problem is going to worsen within the next 20 years. By 2000 AD or shortly thereafter, there should be a reduction in the levels of SO2 to present levels; the fluoride pollution problem will probably be worse; and, unless a power plant such as the electric engine is developed to take the place of the gasoline engine, our major problem will probably be one of photochemical air pollutants. It is also quite likely that pollutants such as hydrogen chloride and chlorine will increase in importance in the future. Finally, it should be kept in mind that the accuracy of predictions of this type is subject to changes in attitudes and technology. (Author's summary)

12587

Kelso, Gary

EMISSIONS FROM A CARBON ANODE BAKE PLANT AT CONSOLIDATED ALUMINUM CORPORATION, LAKE CHARLES, LOUISIANA. Midwest Research Institute, Kansas City, Mo., Office of Air Programs Contract 68-02-0228, Proj. 3585-C, Task 19, MRI Task 20, Rept. 73-ALR-3, 84p., Jan. 29, 1973. 2 refs.

Source emission tests were conducted at the Consolidated Aluminum Corp. s aluminum reduction plant at Lake Charles, La. A summary of results from the fluoride and mass particulate tests conducted on the stack (behind an electrostatic precipitator), and the Orsat analysis of the stack gas are tabulated. Three fluoride tests were run. There was close agreement (16.58 lb/hr and 16.81 lb/hr, respectively), in the first two tests, while the third test had a lower value (15.69 lb/hr). The total mass particulate emissions test which was run with the third fluoride test had a value of 74.77 lb/hr. Twelve separate Orsat analyses were run on the gas sample and are tabulated. Results of the tests are carbon dioxide-average-1.1%; oxygen-average-19.0%; and carbon monoxide- average-0.0%. These data will be used to establish performance standards for the industry. (Author summary modified)

12622

Boehlen, B.

FLUORINE EMISSION AT ALUMINIUM WORKS. Chem. Eng., No 221, CE266-268, Sept. 1968.

The most important of the extraneous substances in the air which arise from alumina reduction are inorganic fluorine compounds, alumina, tar, carbon, sulfur dioxide, and carbon monoxide. The fluorine compounds are particularly important because of their toxicity to livestock and plants. Waste gas purification systems must be of two types: One for purification of the furnace waste gas and the other for purification of air from the premises. The first system for use with the Soderberg furnace consists of a combustion step with cyclone and electrostatic precipitator dust removal, and spray-type scrubbers or filter-plate columns for hydrogen fluoride removal. The system for purification of air from the premises consists of a spray chamber with synthetic fabric lining mounted on the roof. Purification of waste furnace gases from Soderberg furnaces results in a fluorine concentration in the pure gas of less than 10 mg/cu m, while the purification of air from the premises results in a fluorine concentration in the pure gas less than 2 mg/cu m.

12631

K. Karbe

FLUORIDE EMISSION FROM FERTILIZER PRODUCTION. Chem. Eng., No. 221, CE268, Sept. 1968.

Crude phosphates, which are important starting materials for the production of fertilizers, generally contain 3-4% fluorine compounds. In this brief statement to the Working Party on Air Pollution of the European Federation of Chemical Engineering, the emission reactions and the waste gas purification methods are defined.

12676

Valentine, Fisher, and Tomlinson, Seattle, Wash., and Office of Air Programs, Research Triangle Park, N. C., Emission Testing Branch and Industrial Studies Branch

HARVEY ALUMINUM, THE DALLES, OREGON. OAP Contract 68-02-0236, Rept. 72-MM-07, 121p., 1973.

Harvey Aluminum was considered a well controlled stationary source in the aluminum reduction industry and was, therefore selected by the Office of Air Programs for the emission testing program to determine performance standards. Testing at the bubbler- electrostatic precipitator (ESP) site included determination of particulate and fluoride emissions. Samples were collected at the inlet to the bubbler and at the stack outlet of the ESP. Testing was also conducted for fluorides and particulates in the secondary system. This included sampling sites before and after the spray chambers in the spray tower. Three particulate and three fluoride runs were made at each inlet and outlet sampling site for both the primary and secondary systems. The particulate emission data indicated that the major portion of the reaction cell exhaust was going through the primary system while the remaining exhaust went through the secondary control system The combined probe and filter catch at the primary system inlet ranged from 42.41 lbs/ton feed to 136.80 lbs/ton feed while at the primary dsystem outlet the range was from 0.0395 lbs/ton feed to 0.0736 lbs/ton feed. The total catch, which includes the impinger portion of the train, ranged from 44.90 lbs/ton feed to 138.63 lbs/ton feed at the inlet and from 0.100 lbs/ton feed to 0.1325 lbs/ton feed at the outlet. The particulate emissions in the probe and filter catch at the inlet of the secondary system ranged from 16.46 lbs/ton feed to 27.19 lbs/ton feed while the outlet ranged from 2.61 lbs/ton feed to 12.46 lbs/ton feed. The total catch at the inlet had a range of 22.38 lbs/ton feed to 30.90 lbs/ton feed while the outlet ranged from 4.77 lbs/ton feed to 16.91 lbs/ton feed. The fluoride emission results were divided into soluble and total fluorides. The soluble fluoride emissions at the inlet of the primary system ranged from 30.97 lbs/ton feed to 41.44 lbs/ton feed and at the outlet from 0.101 lbs/ton feed to 0.0140 lbs/ton feed. The total fluorides at the inlet ranged from 32.57 lbs/ton feed to 92.80 lbs/ton feed while at the outlet the range was from 0.0101 lbs/ton feed to 0.0161 lbs/ton feed. The secondary system (spray tower) ranges for soluble fluorides were 0.639 lbs/ton feed to 0.839 lbs/ton feed for the inlet, and 0.551 lbs/ton feed to 1.026 lbs/ton feed for the outlet. The total fluorides for the inlet and outlet of the secondary system ranged from 0.638 lbs/ton feed to 0.873 lbs/ton feed and from 0.164 lbs/ton feed to 0.273 lbs/ton feed respectively.

12692

Valentine, Fisher and Tomlinson, Seattle, Wash., and Office of Air Programs, Research Triangle Park, N. C., Emission Testing Branch

REYNOLDS ALUMINUM, LONGVIEW, WASHINGTON. OAP Contract 68-02- 0236, Rept. 72-MM-08, 85p., 1973 (?). 2 refs.

To set realistic performance standards for the aluminum reduction industry, Reynolds Aluminum, a well-controlled source, was studied. Three particulate and three fluoride runs were made at the inlet and outlet of the electrostatic precipitator (ESP). Four fluoride runs were made at the roof monitor. Almost all of the exhaust from the aluminum reduction reaction cell is caught by the hood. Therefore, to be assured of an adequate amount of sample at the roof, it had to be sampled for approximately 10-15 hr at a high sampling rate. The combined probe, cyclone and filter particulate catch at the ESP inlet ranged from 60.8 lbs/ton feed to 73.5 lbs/ton feed while at the outlet it ranged from 1.39 lbs/ton feed to 4.98 lbs/ton feed. The total particulate catch ranged from 74.5 lbs/ton feed to 90.8 lbs/ton feed at the inlet and 3.21 lbs/ton feed to 8.91 lbs/ton feed at the outlet. The fluoride emissions results were analyzed as solution fluorides and total fluorides. The soluble fluoride emissions at the inlet of the ESP ranged from 24.4 lbs/ton feed to 36.6 lbs/ton feed and at the outlet from 0.365 lbs/ton feed to 0.422 lbs/ton feed. The total fluoride catch at the inlet ranged from 35.0 lbs/ton feed to 50.4 lbs/ton feed while at the outlet it ranged from 0.382 lbs/ton feed to 0.422 lbs/ton feed. The soluble fluorides at the roof monitor ranged from 1.09 lbs/ton feed to 2.76 lbs/ton feed. The total fluoride catch at the roof monitor ranged from 1.10 lbs/ton feed to 2.85 lbs/ton feed. (Author summary)

12740

Valentine, Fisher, and Tomlinson, Seattle, Wash.

ALCOA, ALUMINUM, WENATCHEE, WASHINGTON. FINAL REPORT. Office of Air Programs Contract 68-02-0236, Rept. 72-MM-06, 104p., 1972. 1 ref.

Alcoa Aluminum in Wenatchee was considered a well controlled stationary source in the aluminum reduction industry and was, therefore, selected for the emission testing program to determine reasonable performance standards. Testing at the A-398 site included determination of particulate and fluoride emissions. Samples were collected at the inlet to the fluidized bed and at the outlet of the baghouse. Sampling for fluorides was also conducted at the roof monitor using a portable roof takeoff system which Alcoa uses in its own testing program. The combined probe, cyclone, and filter catch for the particulate emissions at the inlet of the A-398 ranged from 95.8 lbs/ton feed to 1.39 lbs/ ton feed. The total particulate catch, which includes the impinger portion of the train, at the A-398 ranged from 97.4 lbs/ton feed to 101 lbs/ton feed at the inlet and 1.32 lbs/ton feed to 2.54 lbs/ton feed at the outlet. The soluble fluoride emissions at the inlet and outlet of the A-398 ranged from 17.3 lbs/ton feed to 36.8 lbs/ton feed and 0.0547 lbs/ton feed to 0.260 lbs/ton feed respectively. The roof monitor soluble fluoride emissions ranged from 1.09 lbs/ton feed to 1.34 lbs/ton feed. The total fluoride emissions at the inlet of the A-398 ranged from 17.4 lbs/ton feed to 51.7 lbs/ton feed while at the outlet they ranged from 0.0547 lbs/ton feed to 0.267 lbs/ton feed. The total fluoride emissions at the roof monitor ranged from 1.10 lbs/ton feed to 1.37 lbs/ton feed.

12741

Environmental Engineering, Inc., Gainesville, Fla.

C. F. CHEMICALS, INC. DIAMMONIUM PHOSPHATE, BARTOW, FLORIDA. Environmental Protection Agency Contract CPA-70-82, Rept. 71-CI- 37, 135p., Dec. 1971. 1 ref.

Emission tests were conducted at the C. F. Chemicals, Inc. diammonium phosphate plant No. 3 located in Bartow, Fla. Dec. 16-20, 1971. Using separate sample trains, measurements were made for both total fluorides and ammonia in the inlet and outlet ducts of the reactor, cooler, and dryer scrubbers. Grab samples of the scrubbing liquids, the process reactants, and the process products were taken and analyzed for fluoride and phosphorus pentoxide content. Pertinent results of the tests are tabulated. The plant operated under normal process conditions during the three test runs. However, minor irregularities occurred in the sampling and there are irregularities in the test data. The data was obtained for use by the Industrial Studies Branch and Performance Standards Branch of the Environmental Protection Agency.

12747

Environmental Engineering, Inc., Gainesville, Fla.

ROYSTER COMPANY DIAMMONIUM PHOSPHATE, MULBERRY, FLORIDA. Environmental Protection Agency Contract 68-02-0232, Rept. 72-CI- 25, 165p., May 1972. 1 ref.

Emission tests were conducted at the Royster Co. diammonium phosphate production facilities in Mulberry, Fla., May 17-18, 1972 for the Industrial Studies Branch and the Performance Standards Branch of Environmental Protection Agency. Using separate sample trains, measurements were made for both total fluorides and ammonia. Emission tests were conducted in the inlet and outlet ducts of the reactor, cooler, and dryer scrubbers as well as in the common outlet to the atmosphere. Grab samples of the scrubbing liquid, the process reactants, and the process products were analyzed for fluoride and P2O5 (phosphorus pentoxide) content. Although scrubber operation appeared normal during the tests, it was subsequently determined that an abnormal acid mist entrainment problem existed. This resulted in higher than normal fluoride emissions to the atmosphere and also explains why in all cases fluoride concentrations measured at the scrubber outlets were greater than the concentrations measured at the inlets. A complete summary of the gas conditions, fluoride concentrations, and ammonia emission levels are tabulated. (Author summary modified)

12749

Neulicht, Roy M. and John M. Reynolds

C. F. CHEMICALS, INC. WET PROCESS PHOSPHORIC ACID, BARTOW, FLORIDA. Environmental Engineering, Inc., Gainesville, Fla., Environmental Protection Agency Contract CPA-70-82, 72p., Dec. 1971. 1 ref.

Emission tests were conducted at the C. F. Chemical s Inc., wet process phosphoric acid plant no. 3 located in Bartow, Fla. Three tests runs were conducted on Dec. 14-15, 1971. The scrubber inlet from the attack tank showed fluoride emissions ranging from .452-.907 lb/ton P2O5 (phosphorus pentoxide) fed. At the inlet from the filtration system, the fluoride emissions ranged from .0025-.0042 lb/ton P2O5 fed, while emissions at the inlet from the condenser ranged from .005-.006 lb/ton P2O5 fed. At the scrubber outlet, total fluoride emissions ranged from .011-.064 lb/ton P2O5 fed. Compared to the other two test runs, the value obtained for the first run (.064 lb/ton P2O5 fed) is extremely high. This irregularity is unexplainable, except for the possibility that the sample for run 1 was contaminated. Scrubber efficiency was calculated and ranged for 93.0% to 98.7%. A complete summary of the test results are tabulated.

12750

Environmental Engineering, Inc., Gainesville, Fla.

TEXAS GULF, INC. SUPER PHOSPHORIC ACID. AURORA, NORTH CAROLINA. Environmental Protection Agency CPA-70-82, Rept. 71-CI-32, 29p., Nov. 19, 1971. 1 ref.

Emission tests were conducted at the Texas Gulf, Inc. phosphate complex to obtain data on soluble and insoluble

fluorides in the outlet stack of the off-gas scrubber. Grab samples of the scrubbing liquid, the process reactant, and the process product were also analyzed for fluoride content. Sampling and analytical methods, results, process description, location of sampling points, and emission calculations and results are discussed. The data will be used by the Industrial Studies Branch and the Performance Standards Branch of the Environmental Protection Agency.

12773

Environmental Engineering, Gainesville, Fla.

S. W. BROOKLYN MUNICIPAL INCINERATOR, NEW YORK, NEW YORK. FINAL REPORT. Environmental Protection Agency Contract CPA-70-82, Task 1, Rept. 71-CI-15, 160p., 1972. 2 refs.

Source tests for the determination of particulates, sulfur dioxide, nitrogen oxides, hydrogen chloride, fluoride, special metals, and mercury emissions were performed at Unit Number 1 of the Southwest Brooklyn Municipal Incinerator. Control equipment utilized in Brooklyn was a Wheelabrator electrostatic precipitator. Three particulate test runs were performed at the inlet and outlet of the incinerator. Several gaseous emission tests were performed at the outlet only. Only Orsat analyses for carbon dioxide, oxygen, and carbon monoxide were performed at both inlet and outlet. Inlet particulates (probe, cyclone, and filter catch) measured 0.3744, 0.3783, and 0.3714 gr/SCFD. Particulate total catch was 0.3814, 0.3822, and 0.3790 gr/SCFD. At the outlet SO2 was 1.1, 0.3, and 0.3 ppm, NOx was 28.9, 44.3, and 44.8 ppm, and HCl was 63.1, 15.4, and 38.2 ppm. Outlet particulates (probe, cyclone, and filter catch) were 0.1642, 0.1679, and 0.0983 gr/SCFD, and total particulates were 0.2013, 0.2048, and 0.1347 gr/SCFD. Data will be used to determine realistic performance standards.

12809

Environmental Engineering, Inc., Gainesville, Fla.

TEXAS GULF, INC. SUPERPHOSPHORIC ACID, AURORA, NORTH CAROLINA. AUGUST 29-30, 1972. Environmental Protection Agency Contract 68-02-0232, Rept. 73-PSA-1, 43p., Aug. 1972. 1 ref.

Emission tests were conducted at the Texas Gulf, Inc. superphosphoric acid production facilities in Aurora, N. C., Aug. 29-30, 1972 for the Industrial Studies Branch and the Performance Standards Branch of the Environmental Protection Agency. Three 2 hr tests were made and the outlet stack of the off-gas scrubber was measured for soluble and insoluble fluorides. Grab samples of the scrubbing liquid, the process reactant, and the process product were analyzed for fluoride and phosphorus pentoxide content. The total fluoride for the three runs was 0.002 gr/SCF, 0.002 gr/SCF, and 0.003 gr/SCF respectively. This is equivalent is total fluoride in lb/hr of 0.005, 0.005, and 0.007 for the three runs.

12813

Environmental Engineering, Inc., Gainesville, Fla.

TEXAS GULF, INC., WET PROCESS PHOSPHORIC ACID, AURORA, NORTH CAROLINA. Environmental Protection Agency Contract 68-02-0232, Rept. 73-PSA-2, 62p., Sept. 1972. 1 ref.

Emission tests were conducted at the Texas Gulf, Inc. phosphoric acid plant in Aurora, N. C. Aug. 31-Sept. 1, 1972 for use in setting performance standards. Measurements for soluble and insoluble fluorides were made in the inlet ducts and outlet stack of the fume scrubber. The inlet leading from the attack tank and the combined inlet leading from the filtration system--condenser hotwell system were sampled. Numerous grab samples of the process reactants and products were analyzed for fluoride and phosphorus pentoxide content. There are two identical production lines--the East Train and the West Train. The first two test runs (1W, 2W) were performed on the West Train; the third test (3E) was conducted on the East Train. At the outlet, total fluoride was 13.9 mg, 14 mg, and 2.2 mg for Runs 1W, 2W, and 3E respectively; in the reactor scrubber inlet the total fluoride was 178.3 mg, 121.1 mg, and 283.4 mg; at the filter and miscellaneous scrubber inlet, total fluoride was 138.2 mg, 6.7 mg, and 1.4 mg.

12822

Environmental Engineering, Inc., Gainesville, Fla.

W. R. GRACE AND COMPANY. GRANULAR TRIPLE SUPERPHOSPHATE STORAGE. BARTOW, FLORIDA. Environmental Protection Agency Contract 68-02-0232, Rept. 73-FRT-12, 42p., Sept. 21-22, 1972. 1 ref.

Three test runs of 2 hr each were conducted at a granular triple superphosphate storage building at the W. R. Grace and Company phosphate works. Measurements for soluble and insoluble fluorides were made at the outlet stack of the storage building scrubber. Grab samples of the scrubbing liquid and storage product were analyzed for fluoride and phosphate (P2O5) content. A schematic flow diagram of the process operation and the sampling location, pertinent test results, and complete test data are given. The amount of granular triple superphosphate located in storage during the test runs was approximately 2000 tons P2O5 product. Normal production and shipping operations were taking place during the test runs. No problems were encountered during the sampling. Locations of sampling points, sampling and and analytical procedures, and laboratory analysis procedures are described. The data will be used by the Industrial Studies Branch and the Performance Standards Branch of the Environmental Protection Agency.

12828

Environmental Engineering, Inc., Gainesville, Fla.

ROYSTER COMPANY. RUN-OF-PILE TRIPLE SUPERPHOSPHATE. MULBERRY, FLORIDA. Environmental Protection Agency Contract 68-02-0232, Rept. 73-FRT-11, 48p., Sept. 19-20, 1972. 1 ref.

Emission tests were conducted at the Royster Chemical phosphate works. Royster s scrubbing system is designed so that the stack gas from the scrubber is split into the streams and vented to the atmosphere by two stacks. Both stacks were tested simultaneously for soluble and insoluble fluorides. In addition, grab samples of the scrubbing liquids, the process reactants, and the product were analyzed for fluoride and phosphorus pentoxide content. A schematic flow diagram of the process operation and the sample locations and pertinent test results are presented. The total fluoride emissions for the three runs were 0.18, 0.30, and 0.15 lbs/ton P2O5. The process, sampling points, and sampling and analytical methods are described. The data will be used by the Industrial Studies Branch and the Performance Standards Branch of the Environmental Protection Agency.

12884

Environmental Engineering, Inc., Gainesville, Fla.

C. F. CHEMICALS, INC. RUN-OF-PILE TRIPLE SUPERPHOSPHATE. PLANT CITY, FLORIDA. Environmental Protection Agency Contract 68-02- 0232, Rept. 73-FRT-10, 45p., Sept. 14-15, 1972. 1 ref.

Emission tests were conducted at the C. F. Chemical phosphate works. Three 2-hour tests were performed at the run-ofkpile triple superphosphate production facilities. Soluble and insoluble fluorides were measured at the off-gas outlet to the atmosphere. In addition, grab samples of the scrubbing liquids, process reactants, and process products were analyzed for fluoride and phosphorus pentoxide (P2O5) content. A schematic flow diagram of the process operation and the sample location is presented. The plant was operated under normal process conditions during the test runs. Stack gas conditions, fluoride emissions, process description and operation, location of sampling points, sampling and analytical procedures, and emission calculations and results are presented. The data will be used by the Industrial Studies Branch and the Performance Standards Branch of the Environmental Protection Agency.

12886

Environmental Engineering, Inc., Gainesville, Fla.

W. R. GRACE AND COMPANY GRANULAR TRIPLE SUPERPHOSPHATE, BARTOW, FLORIDA. Environmental Protection Agency Contract 68-02-0232, Rept. 72-CI-30, 66p., June 1972. 1 ref.

Emission tests were conducted at the W. R. Grace and Co. phosphate works in Bartow, Fla. On June 14-15, 1972, three test runs of approximately 2 hr each were conducted on the granular triple superphosphate process in order to get data for determining performance standards. Measurements were made for total fluorides at the outlet stack and at the inlet ducts to the dryer and miscellaneous scrubbers. Grab samples of the scrubbing liquids, the process reactants, and the process products were analyzed for fluoride and phosphorus pentoxide content. At the outlet, the total fluoride was the three runs was 9.07 mg, 6.7 mg, and 6.9 mg; at the dryer scrubber inlet, total fluoride was 5116.7 mg, 1212.6 mg, and 72.0 mg; at the miscellaneous scrubber inlet, total fluoride was 472 mg, 7.3 mg, and 153.8 mg. No explanation for these irregularities could be confirmed. A complete summary of stack gas conditions, emission concentrations, and system efficiency is tabulated. (Author summary modified)

12888

Environmental Engineering, Inc., Gainesville, Fla.

W. R. GRACE AND COMPANY. GRANULAR TRIPLE SUPERPHOSPHATE STORAGE. BARTOW, FLORIDA. Environmental Protection Agency Contract 68-02-0232, Rept. 72-CI-30B, 36p., June 14-15, 1972. 1 ref.

Emission tests were conducted at the W. R. Grace and Company phosphate runs to obtain emission data for the Industrial Studies Branch and Performance Standards Branch of the Environmental Protection Agency. Measurements for soluble and insoluble fluorides were made at the outlet stack of the storage building scrubber. Grab samples of the scrubbing liquid and storage product were analyzed for fluoride and triple superphosphate. A schematic flow diagram of the process operation and sampling location is given. The amount of granular triple superphosphate located in storage during the test runs was approximately 4500 tons. Normal production and shipping operations took place during test runs. No irregularities occurred during the sample. A summary is given of stack conditions and emission levels for each test, and complete results are listed. The location of sampling points, sampling and analytical procedures, and emission calculations and results are described.

12889

Environmental Engineering, Inc.

SEVENTY-THIRD STREET MUNICIPAL INCINERATOR, NEW YORK, NEW YORK. FINAL REPORT. Environmental Protection Agency Contract CPA-70-82, Task 1, Rept. 71-CI-14, 150p., 1972. 1 ref.

Source tests for the determination of particulates, sulfur dioxide, nitrogen oxides, hydrogen chloride, fluoride, special metals, and mercury emissions were performed. Control equipment utilized was a venturi water scrubber. One particulate emission test was performed at the inlet to the control unit, while three particulate test runs were performed at the outlet. Several gaseous emission tests were performed at the outlet only. Only Orsat analyses for carbon dioxide, oxygen, and carbon monoxide were performed at both the inlet and outlet. Inlet particulates at probe, cyclone, and filter were 1.0856 gr/SCFD; the total catch was 1.2382 gr/SCFD. Outlet particulates at probe, cyclone, and filter were 0.0842, 0.0888, and 0.0830 gr/SCFD; total catch was 0.1026, 0.1088, and 0.1067 gr/SCFD. Outlet SO2 emissions were 3.6 and 1.4 ppm; NOx were 32.7, 51.8, and 69.1 ppm; and HCl were 17 0, 97.1, and 108.0 ppm. Data will be utilized to determine realistic performance standards.

12919

Environmental Engineering, Inc., Gainesville, Fla.

INTERNATIONAL MINERALS AND CHEMICALS DICALCIUM PHOSPHATE, BARTOW, FLORIDA. Environmental Protection Agency Contract CPA-70-82, Rept. 72-CI-21, 90p., March 1972. 1 ref.

Emission tests were conducted at the International Minerals and Chemicals dicalcium phosphate production facilities in Bartow, Fla. March 13-14, 1972 for the Industrial Studies Branch and the Performance Standards Branch of the Environmental Protection Agency. Measurements for total fluorides were made at the inlet and outlet ducts of the reactor-granulator, dryer, and screen-mill scrubbers. Grab samples of the scrubbing liquids, the process reactants and the process product were analyzed for fluorides and phosphorus pentoxide content. A complete summary of stack conditions, emission levels, and scrubber efficiencies for each test run and test location is tabulated.

12929

Environmental Engineering, Inc., Gainesville, Fla.

ROYSTER COMPANY. RUN OF PILE TRIPLE SUPERPHOSPHATE. MULBERRY, FLORIDA. Environmental Protection Agency Contract 68-02-0232, Rept. 72-CI-18, 77p., Feb. 29-March 1, 1972. 1 ref.

Emission tests were conducted at the Royster Company triple superphosphate plant. Total fluorides were measured at the scrubber inlet duct and at the two outlet stacks to the scrubber. The emissions from the mixing cone were also measured. Grab samples of the scrubbing liquid, the process reactants, and the process product were analyzed for fluoride and phosphorus pentoxide (P2O5) content. A schematic flow diagram of all sampling locations and complete test results are given. All process and scrubber operating conditions were normal during the three test runs. No major sampling problems were encountered. For the third test run, both the percent stack gas moisture and the fluoride concentration for the north and south outlet stacks were extremely low compared to the other two test runs. No explanation was available for this anomaly. Stack gas conditions, fluoride emission levels, and scrubber efficiencies for each test run are given. Process

description and operation, location of sampling points, sampling and analytical methods, and test data and results are presented. The data will be used by the Industrial Studies Branch and the Performance Standards Branch of the Environmental Protection Agency.

12931

Environmental Engineering, Inc., Gainesville, Fla.

BORDEN CHEMICAL, INC. GRANULAR TRIPLE SUPERPHOSPHATE STORAGE. PINEY POINT. Environmental Protection Agency Contract CPA-70-82, Rept. 72-CI-5B, 52p., Jan. 24, 1972. 2 refs.

Emission tests were conducted at the Borden Chemical, Inc. phosphate works. Total fluorides were measured at the inlet and outlet ducts of the storage off-gas scrubber and grab samples of the scrubbing liquid were taken during the test runs and analyzed for fluoride content. A schematic flow diagram of the process operation and the sampling locations are given. The amount of granular triple superphosphate located in storage during the test runs was approximately 1400 tons. Loading of the product into rail cars took place during test runs. No major problems were encountered during the sampling. Stack conditions and fluoride concentrations for each test point, sampling and analytical procedures, emission calculations, and results are presented. The data will be used by the Industrial Studies Branch and the Performance Standards Branch of the Environmental Protection Agency.

12933

Environmental Engineering, Inc., Gainesville, Fla.

W. R. GRACE AND COMPANY WET PROCESS PHOSPHORIC ACID, BARTOW, FLORIDA. Environmental Protection Agency Contract CPA-70-82, Rept. 72-CI-1, 81p., Jan. 1972. 1 ref.

Emission tests were conducted at the W. R. Grace and Co. wet process phosphoric acid plant located in Bartow, Fla., Jan. 4-5, 1972 for the Industrial Studies Branch and the Performance Standards Branch of the Enviromental Protection Agency. Measurements for soluble and insoluble fluorides were made in the inlet ducts and outlet stack of the crossflow scrubber. The inlet leading from the attack tank and the inlet leading from the filtration system were sampled. Numerous grab samples of the process reactants and products were taken and analyzed for fluoride and phosphorus pentoxide (P2O5) content. For runs one, two, and three, respectively, the scrubber inlet from the attack tank showed fluoride emissions of 0.0333, 0.182, and 0.187 lb/ton P2O5 fed. Emissions at the inlet from the filtration system were 0.031, 0.025, and 0.024 lb/ton P2O5 fed, while at the scrubber outlet to the atmosphere, total fluoride emissions were 0.004, 0.008, and 0.004 lb/ton P2O5 fed. From this data, scrubber efficiency was calculated to be 93.3%, 96.0%, and 97.7% for runs one, two, and three, respectively. A complete summary of stack gas conditions, sample volumes collected, and fluoride emissions are tabulated. (Author summary modified)

13242

Hollander, Egon

CONDITIONS FOR RELEASING FLUORINE DURING THE DECOMPOSITION OF PHOSPHATES WITH SULFURIC ACID. (Podmienky uvolnovania fluoru pri rozklade fosfatov kyselinou sirovou). Text in Czech. Chem. Prumysl (Prague), 18(2):65-67, 1968. 14 refs.

Conditions were determined for releasing fluorine, during the decomposition of the most commonly used natural phosphates by means of acids. In the decomposition of fluoride phosphate, relatively little fluorine is released: 31% in the USA, 40 to 45% in the USSR, and 33.7 to 42.8% in Czechoslovakia. In manufacturing concentrated and combined fertilizers, where the amount of fluorine released is considerably less, additional fluorine is released through the manufacture of the superphosphate. Factors that influence the process include type of phosphate, temperature, concentration, fineness of the grain, and the amount of acid used. The higher the concentration of sulfuric acid, the greater the concentration of phosphoric acid. When concentrations of phosphoric acid range to 30% P205 at temperatures of 95 to 100 C, evaporation of the acid is low; with more than 40% of P205, evaporation rises sharply. The amount of fluorine released is directly proportional to the temperature, the amount of acid used for the reaction, and the fineness of phosphor grain. The reaction is also facilitated by using active matter with the acid.

13353

Cross, F. L., Jr. and R. W. Ross

FLUORIDE EMISSIONS FROM PHOSPHATE PROCESSING PLANTS. Fluoride Quarterly, J. Intern. Soc. Fluoride Res., 2(2):97-105, April 1969. 4 refs.

A three-part study to determine the extent of an area affected by fluoride emissions from a phosphate plant gypsum pond led to the following conclusions: Monitoring of fluorides by static air samplers at distances up to 8000 ft from the pond indicates a break point in concentration at one-half mile. The F levels drop off rapidly to this break point. In citrus leaves from groves close to the pond, fluoride concentrations up to 75 ppm were found in spring flush. Similar amounts were found in young leaves at one-half mile from the pond. Concentrations taken before November may serve as an indicator of air pollution which can result in a reduction of citrus yield. A one-mile protective buffer zone for a phosphate plant might be considered adequate for citrus groves but would not necessarily be adequate for row crops or ornamental flowers such as gladioli. Studies conducted on the surface of the pond by means of a specially constructed sampling shelter demonstrated fluoride emissions up to 0.16 lb/acre/day. At least 26 lbs of fluoride/day were emitted from the 160-acre pond. (Author conclusions modified)

13615

Knabe, Wilhelm

EXPERIMENTAL STUDY OF THE FLUORINE CONCENTRATION IN NEEDLES AND LEAVES OF PLANTS AS FUNCTION OF THEIR HEIGHT ABOVE GROUND. (Experimentelle Pruefung der Fluoranreicherung in Nadeln und Blaettern von Pflanzen in Abhaengigkeit von deren Expositionshoehe ueber Grund.) Translated from German. Landesanstalt fuer Immissions und Bodennutzungsschutz des Landes Nordrhein- Westfalen, Essen (Germany), p. 101-116, Sept. 1968. 6 refs.

The ability of many types of plants to absorb fluorine from the air and store it in the leaves makes this pollutant particularly well suited for studies of the pollutant intake by plants, as function of the immissions in ground level atmospheric layers. Therefore, field tests were performed of a distance of 4.6 km from a fluorine emitting aluminum factory. The plants were set up in containers at various heights above ground. The factory emits approximately 30 kg F/h, about 80 percent in the gasepis state and 20 percent as dust. The wider aim of the experiments was to find correlations between the amount of excessive fluorine in plants and characteristic immission parameters. In the narrower range of our field experiments, the fluorine in-

take of overground plant organisms as a function of the height of the plant above ground was studied. All plants had the same soil and the same water supply. A detailed description is given of the experimental procedures and equipment. The results pertain only to the period from October to November, and October to February, respectively, and only to fluorine containing emissions from one aluminum plant. The increase of the fluorine content in plant organisms with increasing height above ground or in the first row facing the aluminum plant in ghe fall and winter of 1967/68 confirms earlier field experiments. For further analyses of the fluorine content in plant organisms it must be kept in mind that not only the physiological age and the sampling time but also the height above ground and the position toward the emission source ought to be comparable.

13699

MacDonald, H. E.

FLUORIDE AS AIR POLLUTANT. Fluoride Quarterly, J. Intern. Soc. Fluoride Res., 2(1):4-12, Jan. 1969. 31 refs.

Fluoride compounds reach the air from two sources: volcanic action and man's industrial activities. The two greatest acute air pollution episodes occurred in Belgium's Meuse Valley and in Donora, Pa. In both disasters, there was evidence of acute fluoride poisoning. The sources of industrial fluoride pollution are coal, clay, cryolite, fluorspar, hydrogen fluoride, and phosphate rock. About half the bituminous coal consumption in the United States for 1963 was utilized by electric power utilities. Vegetation in several counties in California has been adversely affected by fluoride emissions from brick, tile, and pottery factories. Cryolite, used in the production of aluminum, has been traced as a source of damage to vegetation, livestock, and human health. Fluorspar and hydrogen fluoride are used in steel production, and the latter is also used in the production of high-octane gasoline. Many cases of eye irritation were recorded shortly after a Los Angeles refinery began using hydrogen fluoride. Fluoride emissions from the production of phosphate fertilizer, phosphoric acid, and phosphorus have been responsible for damage to vegetation and livestock, and respiratory ailments in people. Control of fluoride emission may be achieved by a variety of scrubbers and electrostatic precipitators.

13701

Colombini, M., C. Mauri, R. Olivo, and G. Vivoli

OBSERVATIONS ON FLUORINE POLLUTION DUE TO EMISSIONS FROM AN ALUMINUM PLANT IN TRENTINO. Fluoride Quarterly, J. Intern. Soc. Fluoride Res., 2(1):40-48, Jan. 1969. 5 refs.

For many years, women and children complained of skin lesions similar to suffusions in an area of Trentino, near an aluminum plant. These lesions were first observed in the same place about 30 years ago. The symptomatology is related to damage to the vegetation due to emission of fluorine compounds. Since March 1966, three permanent stations were installed in the area in order to collect volatile fluorine compounds. Since February 1967, five deposit gauges were established at progressively increasing distances from the source. Fluorine air pollution has reached values close to and sometimes above 10 micrograms/ cu m of air. Rain water collected for two weeks in the deposit gauges showed decreasing concentrations of fluorine the greater the distance from the source. The highest value of 7.13 mg/L was found in the deposit gauge closest to the factory. In the inhabited area, the fluorine content ranged between 0.14 and 2.55 mg/L. Since May 1967, the degree of fluorine pollution has decreased following installation of modern purification equipment at the plant. (Author summary modified)

15452

Smith, Ralph I.

AIR-POLLUTION PROBLEMS OF THE PHOSPHATE INDUSTRY. (Bureau of Mines and Geology, Montana, Western Phosphate Region, Proc. Ind. Seminar West. Phosphate Reg., Butte, Mont., 1966, p. 46-48, June 1967. (Special Pub. 42).

Materials from the phosphate industry which contribute to air pollution are listed as follows: solids, such as natural dust and organic particles, industrial dusts such as carbon and fly ash from the combustion of fuels, and fine dusts; gases, such as sulfur dioxide and trioxide, hydrogen fluoride, silicon tetrafluoride, chlorine, hydrogen chloride, carbon monoxide and dioxide, nitrous and nitric oxide, ammonia, alcohols, and ozone; and water vapor and mists, which are liquid from condensation of water and acids on suitable nuclei. The noxious gases come from two sources in the phosphate industry: a wet process called denning, and from calcination processes. As the gases or smoke come out of the stack, they may either continue upward, spread out and diffuse, or an inversion or turbulence may cause a rapid downward trend a short distance from the stack. Smoke and fumes have both psychological effects (depression and general irritation) and physiological effects (the irritation of membranes of the nose, throat, and lungs by the inhalation of gases; a toxic effect in the stomach of animals who eat contaminated vegetation). Methods for the removal of solids are listed as follows: a long flue equipped with baffles and settling chambers; a filtering system such as a bag house; and the cyclone. The most economical and effective way of removing noxious gases is by scrubbing. Sulfur gases may also be sent through a sulfuric acid plant. Fluorine gases may be removed by forcing the gases through a bed of limestone; the absorption causes a chemical reaction to take place, forming inert calcium fluoride. Other removal methods mentioned include the following; electrostatic precipitation; and sonic precipitation.

17076

Belaga, M. B. and P. N. Maystruk

SANITARY PROTECTION OF AIR IN VINNITSA. U.S.S.R. Literature on Air Pollution and Related Occupational Diseases, vol. 8:241-246, 1963. (B. S. Levine, ed.) (Also: Gigiena i Sanitariya, 26(1):73-76, 1961. CFSTI: 63-11570

Plans are presented for the purification of discharges from different shops and departments of a superphosphate plant which currently emits 10.5 tons of sulfur dioxide, 6.5 tons of nitric acid, 1.2 tons of sulfuric acid, 0.5 tons of fluorides, and one ton of superphosphate and tricalcium dust each day. Even at a distance of 2000 meters from the plant, the maximum fluorine concentrations are 13 times in excess of the allowable limit. Similarly, sulfur dioxide concentrations at 1000 meters and sulfuric acid aerosols at 500 meters have been found to exceed allowable limits. The maximum concentration of dust at 200 m from the plant is 15.4 mg/cum, or thirty times in excess of the allowable limit. Dust samples collected at 200-1000 meters from the plant showed a fluorine content of 0.8 to 1.4%. Soil samples at 200, 500, and 1000 meters contained 16.9, 9.61, and 8.7 mg of fluorine per 100 g of soil. Among the measures being taken to reduce pollution are the elimination of gas leaks by equipment hermetization, the installation of dust catching and gas purification equipment, and the construction of high stacks for greater dispersion of pollutants. It is further recommended that the sulfuric acid department build a separate housing for its exhaust fans, use filters to raise tail-gas utilization efficiency, and build a warehouse to store the apatite concentration.

17116

Balazova, G., A. Rippel, E. Hluchan, and J. Ambrus

EVALUATION OF FLUOR CONTENT IN LIVING ORGANISM STANDING UNDER THE EFFECT OF FLUOR EMALATIONS. (Zhodnotenie hladiny fluoru v zivom organizme ovplyvnovanom fluorovymi exhalatmi). Text in Czech. Cesk. Hyg. (Prague), 13(1):12-17, 1968. 21 refs.

Such parameters as air quality, atmospheric fluor content, and content of fluor in dust fall, drinking water, and agricultural products were evaluated in a long-term study carried out in the vicinity of an aluminum plant. At the same time, the fluor content in the teeth, hair, nails, and urine of children living close to the plant was assessed. The mean values of the total fluor content in the air fluctuated from 0.02 to 0.14 mg/F per cu m, and in fallen dust reached up to 7.34 tons of fluor per sq m per yr. The mean fluor content in the drinking water was 0.2 mg/liter. Fluor content in food produced from plants grown in the region fluctuated within 0.5 and 10.0 mg/F/kg, in foods of animal origin within 0.5 and 1.2 mg/F/kg. The fluor content in bones of sparrows, frogs, and rats was two to fourteen times higher than in the controls. The teeth, nails, hairs, and urine of children living in the nearest residential quarter contained an amount of fluor which was twice to three times as large as that of the control children. Examinations in children living in the neighborhood of the plant did not reveal any signs of endemic fluorosis. (Author summary modified)

17344

Knop, Wilhelm

INDUSTRIAL DUSTS AND WASTE GASES. (Industriestaeube und-abgase). Text in German. Wasser Luft Betrieb, 14(1):20-23, Jan. 1970.

The major sources of dangerous and annoying industrial dusts or gaseous pollutants are enumerated. In mines, coking plants, and gas works, dusts develop at the sorting, crushing, and mixing processes. The extent of dust development depends on the water content, the grain size, and the strength of the material. Waste gas and vapor develops behind driers, transportation facilities, and in the quenching of coke. The chemical industry produces the dangerous halogen gases, of which chlorine and bromine are the most harmful. The maximum allowable long-term emission concentration for chlorine is 0.1 cu cm/cu m air; the short-term value is three times daily 0.5 cu cm/cu m air. Hydrogen chloride develops at the manufacture of dyes. The maximum allowable emission concentration for fluorine is 0.5 cu cm/cu m air. Flourine compounds (in gaseous form or dust) develop in aluminum production, fertilizer manufacture, and at the polishing stations for quartz and glass. With sulfuric acid production in a Claus furnace or in the manufacture of dyes SO2 and SO3 develop. The maximum allowable concentration for these pollutants is 0.2 cu cm/cu m air. Hydrogen sulfide has been limited to 0.1 cu cm/cu m air. It develops in refineries in dye and viscose manufacture. A particularly noxious gas is carbon monoxide which develops in phosphorus and carbide plants. Quarries, cement factories, the ceramic industry, mixers for asphalting highways, iron ore sintering plants, blast furnaces, and foundries all are large contributors of dust and gaseous emissions.

17357

Chovin, Paul

CHEMICAL POLLUTION OF THE ATMOSPHERE. (La pollution chimique de l'atmosphere). Text in French. Sci. Progr. Decour., no. 3417; 35-40, Jan. 1970. 6 refs.

A systematic general review is presented of the origin and nature of chemical pollutants of the atmosphere, of their action on living beings, and of the battle against atmospheric pollution. Principle sources of pollutants are the industrial and domestic heating plants. In regions of high industry concentration, steel plants and chemical plants emit specific pollutants. Principal pollutants are sulfur dioxide, sulfur trioxide, carbon dioxide, carbon monoxide, nitric oxide, nitrogen dioxide, fluorine, and light and heavy hydrocarbons. Sulfur dioxide is a byproduct of combustion of fossil fuels containing, on the average, 3% S (coal in France has about 1% S, some foreign coals have up to 6% S). Estimated emission of S is as follows: in France, 2 million tons, in England, 5 million tons, and in the U. S., 40 million tons of S per year. Sulfur trioxide is largely due to oxidation of SO2; it combines with moisture to form H2SO4 which is very noxious. Rain has a beneficial effect by scrubbing the polluted air. Carbon dioxide is the product of complete combustion of C; 500 to 600 million tons are estimated to be emitted in England. Carbon monoxide is the product of incomplete combustion, rather rare in industry, but invariably present in automobile exhaust gas. Nitric oxide and NO2 are present in low concentrations, but a complex photochemical reaction produces one type of smog, ozone, and new chemical compounds such as peracetylnitrate, CH3-CO-OO-NO2, which has a very strong physiological effect. Fluorine and its compounds, such as HF, are emitted by fertilizer and by aluminum plants. Dusts are emitted by industrial and domestic heating plants. The action of air pollutants on bronchi and lungs is disucssed at length. The reaction of the cardio- vascular system and the incidence of broncho-pulmonary cancer are also considered. In the battle against atmospheric pollution laws alone are insufficient, means of measuring emissions, and enforcing compliance are essential.

17377

Rowden, E.

OUTSTANDING AIR POLLUTION PROBLEMS. Brit. Clayworker, 78(930):36-46, Nov. 1969. 7 refs. (Presented at the Clean Air Conference, Eastbourne, Oct. 22.)

The most serious pollution problem in the heavy clay and refractories industries is the brown smoke produced by the firing on blue bricks, roofing tiles, and floor quarries and the firing of salt-glazed pipes in intermittent and continuous grate-fired kilns that are hand fired with coal. In recent years, dark smoke emission has been reduced considerably by the incorporation of oil-fired continuous car tunnel kilns or the conversion of continuous or intermittent kilns to oil- or natural gas-firing. To reduce emissions for existing coal-fired intermittent kilns, modifications of the coal-charging procedure are suggested. Other outstanding problems of the industries concern the new minimum kiln chimney height established by the Alkali Inspectorate and the emission of fumes and acid soots. Many existing stacks will need to have height increases or be replaced by mid-1970. If natural gas becomes available, existing chimneys of small height would be sufficient, except when firing high sulfur or fluorine-bearing clays, or where salt glazing is carried out. The acid soot emission is related to the firing of oil in continuous kilns. Methods for its reduction depend on achieving and maintaining efficient combustion, limiting the sulfur content of the fuel or clay, and preventing acid deposition. Fume emissions are more difficult to deal with than smoke emissions. They present serious problems in the firing of fletton bricks and in the firing in continuous kilns of clays containing sulfur and fluorine compounds. A practical commercial solution has not yet been found for this problem.

17405

Tsunoda, Fumio

A NEW ASPECT OF AIR POLLUTION - FLUORIDES. (Taikiosen mondai no aratano ichi kyokumen - fukkabutsu ni yoru hai o reini). Text in Japanese. Igaku No Ayumi (Progr. Med.), 70(2):621-622, Sept. 27, 1969. 2 refs.

As a result of industrial growth, atmospheric contamination by mercury, lead, fluorine and other compounds is becoming noteworthy. An aluminum refinery in Aizu basin was blamed for the death of all silkworms in the area. Trees shed their fruit prematurely. The harmful compound was: 3NaF-AlF3. The fluorine contained in it contaminated the atmosphere and badly damaged plants. Some plant species were sensitive to only a few ppm. Many accumulate fluorine, paddy and gladiolus. This is the reason why cows and silkworms were poisoned. Also, there is a possibility that human beings accumulate too much fluorine in their bodies. Even a few ppm in the air may exert a direct influence. In the Aizu district, inquiries were made into the effects of long-term exposure to fluorine. Persons who had accumulated fluorine for many years were examined with regards to the quantity of fluorine in urine. lung function, existence of spotted teeth, and bone softening especially the pelvis and the limbs). Results of the study have not yet been issued. The major sources of fluorine are aluminum refineries whose number is expected to increase. In the near future, fluorine will be also used for atomic power industries. It is concluded that the air pollution research has arrived at the stage where not only the atmosphere but also water, soil, and food are objects of study because of an indirect contamination through air.

17464

REMARKABLE MEASURES FOR THE IMPROVEMENT OF AIR QUALITY. (Beachtliche Massnahmen zur Verbesserung der Luft). Text in German. Wasser Luft Betrieb, 14(1):33-36, Jan. 1970.

In 1967, a total of 4 million tons of sulfur dioxide were emitted from industrial sources, particularly power plants. Until 1975, an increase to 5 million tons is anticipated; from then on, the SO2 emission will stagnate and eventually decline, due to the use of nuclear power. Contrary to this downward trend, fluorine, chlorine, hydrocarbons and numerous odorous pollutants are on an upward trend, due to the expanding chemical industry. In the metallurgical industry, the sinter capacity has been doubled; thus, the larger units will emit HCl and larger quantities of gaseous fluorine compounds along with SO2. It is estimated that sintering plants presently already emit as much fluorine compounds as the aluminum plants. No fluorine removal method from the waste gases of the ore sintering plants is yet available. Traffic will further increase, as well as vehicle emissions. Emissions by domestic heaters will decrease because electric or central heating will take the place of old coal or oil fired heaters. To combat the increasing pollution of air by an overall increase of emissions, the state of North-Rhine-Westphalia plans to establish emission inventories. Such inventories have been made in the area around Cologne; other large cities will soon follow.

17471

Knop, Wilhelm

INDUSTIRAL DUSTS AND WASTE GASES. (Industriestaeube und-abgase). Text in German. Wasser Luft Betrieb, 14(2):63-66, Feb. 1970. 22 refs.

The most dangerous and annoying pollutants emitted by various industries are enumerated. Steel mills emit primarily iron oxides and fluorine compounds. Half of the original fluorine input is emitted; the other half goes into the slag. The iron oxide emissions, primarily the small particles below 3 micron, form the brown smoke. The non-ferrous metal fabricating and finishing plants emit metal oxides (cadmium oxide). When inhaled, the latter may be extremely harmful. The TLV (threshold limit value) is 0.1 mg/cu m air. In aluminum production, dust-laden waste gases develop, despite the wet process. The aluminum oxide dust content in the rotary furnace is 300-400 g/standard cu m. In electrolytic reduction of aluminum oxide, cryolite also dissociates. As a consequence, hydrogen fluoride and dusts of fluorine compounds are found in the waste gas. The TLV for fluorides is 2.5 mg/cu m; for hydrogen fluoride, 2 mg/cu m. In lead plants 3 to 3.5 cu m waste gases per kg sinter develop in the sintering and roasting station. They contain 1.5 to 5% by volume SO2 and up to 15 g/cu m dust. The dust contains lead, zinc, sulfur, and small amounts of other elements. Considerable amounts of metal vapors develop. In the fly dust of the shaft furnaces, cadmium oxide or sulfate, arsenic, zinc, and thallium compounds may be found. In copper smelting plants, the waste gases contain fly dust and SO2. In zinc refining, fly dust (0.1 g/standard cu m) and SO2 are emitted to the waste gas. In ferro-alloy production, dusts of various kinds are carried along in the waste gases. The waste gas quantity of a 10 MW furnace amounts to 70,000-250,000 cu m/h; the dust content, to 0.25-2.5 g/cu m.

17883

Kiss, Istvan

INDUSTRIAL METHODS FOR ENRICHMENT OF U-235. (Az U-235 dusitasanak ipari modszerei). Text in Hungarian. Energia Atomtech. (Budapest), 11(7-8):466-473, 1958.

Various methods are reviewed for increasing the U-235 concentration of uranium ore. The various procedures for separating a particular isotope include distillation, chemical reaction, thermal diffusion, electrolysis, gas diffusion, and the ultracentrifuge; however, the two last-mentioned methods have been found by statistical studies to be the most suitable. In addition to a study of the theoretical principles of gas diffusion and centrifugation, the isotope enrichment is discussed. Formulas are given for the time required for a cascade to reach equilibrium and for the amount of power required to operate the gas diffusion cascade. The gas diffusion method of separating uranium isotopes uses uranium fluoride (UF6), which sublimates at 56 C. Only one isotope of fluorine occurs naturally, so that the UF6 molecule will have a weight of either 352 or 349, if one neglects the 0.005% content of U-234 that occurs naturally in uranium ore. When the K25 type of diffusion plant is used, the pressure of the entire system has to be kept below atmospheric pressure for the following reasons: the smaller the pressure, the larger the enrichment factor, due to the longer free path of the molecules; there is less possibility of an impact between the UF6 and the tubing; and if a leak were to develop in the equipment, the UF6 would not escape. Uranium fluoride is in itself a poisonous compound, and when diluted by the atmosphere, it is prone to react with the moisture in the air to form hydrogen fluoride gas.

18323

Farkas, M. D. and R. R. Dukes

MULTIPLE ROUTES TO SULFURIC ACID. Chem. Eng. Progr., 64(11): 54-58, Nov. 1968. 5 refs.

Designs show that sulfuric acid plants can be built to utilize SO2 bearing gases from various sources. The high price of sul-

fur and more stringent legislation preventing the discharge of gases containing sulfur dioxide to the atmosphere has generated interest in the utilization of gases from various sources as an alternate raw material. The important characteristics of gases relative to sulfuric acid production are particulate matter, volatile impurities, temperature, SO3 content, acid mist content, and SO2 content. Desirability of the possible sources depends on the relative economy with which each can be handled. Particulate matter and volatile impurities must be removed from the gases before entering the acid plant to prevent corrosion and deactivation of the catalysts. Acid mist also poses a corrosion problem. Chlorides and fluorides present a problem with stainless steel equipment. It is desirable to keep the SO3 content in the gases to a minimum because it represents a yield loss. The SO2 content is the most important economic factor. It should be between 3.5 and 7.5%. Below 3.5% heat must be added to keep the plant in operation. Air must be added if the concentration is above the upper limit.

18449

Webster, Stewart H.

VOLATILE HYDRIDES OF TOXICOLOGICAL IMPORTANCE. J. Ind. Hyg. Toxicol., 28(5):167-182, Sept. 1947. 63 refs. (Presented at the American Industrial Hygiene Association, Annual Meeting, 9th, Chicago, Ill., April 9-11, 1946.)

Among the hydrides of the twenty elements forming volatile hydrogen compounds are some of the most toxic gases, having few uses and generally occurring accidently. The tendency to form complex hydrides is greatest with carbon but is shown also in the neighboring elements (boron, nitrogen, silicon, phosphorus, germanium, and arsenic). Some of the most important physical and chemical properties of the hydrides are summarized, together with useful data, such as formula, molecular weight, and conversion factors. Stability, solubility, odor characteristics, and reducing action are mentioned. With the exception of methane, ammonia, and water, all of the simple volatile hydrides give precipitates with silver nitrate, all except silver chloride being colored. Filter paper can also be used for determinations. Toxicity of the volatile hydrides is discussed. Effects are cited of hydrogen chloride, hydrogen fluoride, sodium fluoride, ammonia, ethylene, acetylene, phosphine, arsine, boron, silicon, hydrogen sulfide, stibine (antimony hydride), hydrogen selenide, and tin hydride.

18656

Henry, Jack L.

A STUDY OF FACTORS AFFECTING FLUORIDE EMISSION FROM 10,000 AMPERE EXPERIMENTAL ALUMINUM REDUCTION CELLS. In: Extractive Metallurgy of Aluminum. (Gary Gerard, ed.), Vol. 2, New York, Interscience, 1962. p. 67-81. 5 refs.

Results are described of experiments aimed at obtaining a better understanding of factors affecting fluoride emission from aluminum reduction cells. The general nature of fume generation is considered with the emphasis placed on the effect of cell operating variables on fluoride emission rate. The study, carried out with 10,000 amp experimental reduction cells with prebaked anodes, showed that cell temperature, bath ratio, and alumina concentration are the most important factors affecting fluoride emission rate. Gaseous hydrogen fluoride generation results principally from the reaction of molten or vaporized bath materials with moisture in the air and hydrocarbons in the carbon anodes. Relatively little hydrogen fluoride is formed from the reaction with moisture in the alumina fed to the cells. The large number of variables involved in aluminum reduction cell operation make it difficult to establish with a high degree of certainty the correlation of operating factors with fluoride emission. This difficulty exists even with small-scale experimental reduction cells operated by research personnel. (Author abstract modified)

19400

Wiener, Howard A., Robert P. Bartell, Thomas L. Hess, and Kenneth N. Ports

ATMOSPHERIC SAMPLING STUDY OF NF ROCKET PROPELLANT, REDSTONE ARSENAL, HUNTSVILLE, ALABAMA, 26 MAY-16 JUNE 1969. Army Environmental Hygiene Agency, Edgewood Arsenal, Md., Rept. 99-003-69/70, 32p., Nov. 14, 1969. 2 refs. CFSTI, DDC: AD 699360

A field study was conducted at Redstone Arsenal, Huntsville, Alabama to measure the concentration of and determine areas of exposure to total fluorides in the exhaust cloud of statically fired six pound motors utilizing a developmental NF propellant. Results of the study gave strong indications that only areas exposed to the visible exhaust would be contaminated by fluorides. The study results also indicated that all fluorides in the exhaust were predominantly in the gaseous state. Areas of greatest exhaust cloud total fluoride concentration were found to be at the approximate location where the cloud was initially formed. In the firing tests conducted, exposure to the cloud at any point within its path was determined to be less than one minute in all cases observed. It was estimated that areas at distances greater than 150 meters from the firing point of the six-pound motors would not be significantly exposed to fluorides from the exhaust. (Author abstract)

20134

Sullivan, J. L.

AIR POLLUTION--CAUSES AND CONTROL. Occupational Health Rev. (Ottawa), 20(3-4):9-23, 1968-69.

Pollution due to the burning of liquid and gaseous fuels, and industrial emissions is discussed; methods for measuring solid particles and gases are described, and their prevention or elimination is considered. Gasoline internal combustion engines seldom burn fuel completely, resulting in discharges of carbon monoxide and hydrocarbons, while nitrogen oxides occur as the combination of nitrogen and oxygen in air under the influence of high temperatures inside the cylinders of the engine. These compounds are significant as components of sunlight-induced or photo-chemical pollution, causing eye irritation, and damage to vegetation and materials. Diesel exhausts discharge greater quantities of carbon particulates and odorous materials, partly attributable to aldehydes and other fuel decomposition products, than the emissions of the gasoline engine. Lead, zinc, copper and nickel smelting release large quantities of sulfur dioxide, while the manufacture of iron and steel causes visible fine particulate plumes. Gaseous and solid fluoride compounds are evolved by the electrolysis of aluminum oxide, and paper manufacturing results in the escape of odorous sulfide and mercaptan compounds. Soot or dust-fall can be collected very simply in open-top gauges, separated from the water by filtration, then dried and weighed; dust can be measured by means of a device similar to a vacuum cleaner, in which a sample of air is drawn through a filter, composed usually of paper or fibre-glass, and the quantity of dust is determined by subtracting the previously-determined weight of the filter. Gases are often measured continuously by absorption of infrared or ultra violet electromagnetic rays. Legislation for the reduction of emissions has two main objectives: to establish standards and to enforce them. It is preferable to employ methods which do not create pollution,

but filters are mentioned for the many processes which cannot avoid generating dust. Pollution control has been a provincial responsibility in Canada, and specific acts of legislation are cited.

21380

Crane, G. B., D. R. Goodwin, and J. F. Rook

ATMOSPHERIC EMISSIONS FROM WET-PROCESS PHOSPHORIC ACID MANUFACTURING. Preprint, National Air Pollution Control Administration, Washington, D. C., 19p., 1969.

The raw materials, chemical reactions, and plant design for the manufacture of wet-process phosphoric acid are described, and a flow diagram is given. All such plants emit SiF4 and probably to a lesser extent HF. The digester where phosphate rock is decomposed by sulfuric acid is the main source of fluoride emissions; the evaporator where the phosphoric acid is concentrated is a second source; and the filter for the reaction slurry, a third. Other sources are vacuum and flash evaporator hot wells, acid splitter boxes, sumps, and phosphoric acid tanks. Modern designs for emissions control include provisions for sending the various streams to scrubbers adapted to handle each stream. Spray-crossflow packed scrubbers, venturi scrubbers, and others are suitable for these applications. Summaries of the results of a stack testing program carried out at 10 plants are given. It is concluded that it should be possible to operate these plants within acceptable emission ranges at the least if the plants are designed, operated, and maintained to prevent or collect emissions.

22547

Hendrickson, E. R.

THE FLUORIDE PROBLEM. Preprint, Ontario Dept. of Energy and Resources Management, Toronto, Air Management Branch; Air Pollution Control Assoc., Pittsburgh, Pa., TR-7 Agricultural Committee; and Air Pollution Control Assoc., Toronto, Ontario, Ontario Section, 13p., 1970. 3 refs. (Presented at the Proceedings on the Impact of Air Pollution on Vegetation, Toronto, Ontario, April 7-9, 1970, Paper 12856.)

Fluorine is discussed in terms of kinds of compounds, sources, control procedures, and regulations in various parts of the United States. The majority of problems relating to fluorides in the atmosphere involve vegetation, animals through ingestion of vegetation, and materials. Fluorides may be discharged into the atmosphere by combustion of coal, the production of phosphate chemicals and fertilizers, and by several other metallurgical manufacturing processes. The processing of phosphate rock contributes a substantial portion of the total fluoride contamination. Most of the reactive fluorides are readily absorbed in conventional scrubbing systems. Regulations and air quality standards relating to fluoride gases and particulates are discussed.

22875

Spencer, John D.

REVIEW OF BUREAU OF MINES COAL PROGRAM, 1967. Bureau of Mines Information Circ., no. 8385, 99p., June 1968. 72 refs.

Details of environmental studies featured in research and technological work on coal, and other research relating to the mining and utilization of coal are presented. Fly ash is evaluated for use in land reclamation and agriculture. Investigations of desulfurization methods include lime additives, centrifugation, wet tabling, and others. Programs to locate low-sulfur coal have been initiated. Sulfur dioxide recovery from stack gases is accomplished by absorption by alkalized aluminum, chromatographic sorption, manganese oxide absorption, limestone addition, catalytic oxidation, and the Reinluft process. The effectiveness of various methods for decomposing nitric oxide are tested. Costs for cleaning stack gases are estimated. Chlorine removal from gases and stack sampling methods are mentioned. The use of coal as a purification method for sewage is investigated. Studies to determine particle size ranges in mining operations are discussed. Occupational health as it relates to mining is studied. The relationship between coal dust and pneumoconiosis is studied, as well as methane-coal dust explosions. Gas chromatographic methods and ventilating systems used in mines are described. Coal processing and storing methods are discussed. Combustion research on coal as a fuel for power generation is reviewed, and catalysts for hydrogen-oxygen fuel cells are tested. Coke production represents a large market for coal. Gasification research and hydrogenation methods are disclosed. New uses for coal include the production of hydrogen cyanide, carbon black, lignite, and synthetic food for microbes. Composition and properties of coal and coal products are analyzed, and arsenic and fluorine content of coal are determined analytically.

22973

Jensen, Robert M.

INTRODUCTION TO AIR QUALITY CONTROL. Pacer, 1(5):1-14, 1970.

The hazard of and the harm caused by air pollution depend upon concentration and exposure. As can be demonstrated statistically, the incidence of health hazards due to air pollution is about 100 times greater in a city than in a rural area. Transportation contributes nearly 60% of the total atmospheric pollution and yields 74,800,000 tons of pollutants per year; manufacturing is the next biggest producer at 23,400,000 tons per year. The biggest single pollutant is the 65,000,000 tons of deadly carbon monoxide which we pump into our atmosphere each year. There is a large and rapidly increasing amount of evidence which relates air pollution to chronic bronchitis and respiratory cancer. Air pollution damages crops, livestock, shrubbery, and trees. Fluorine compounds in forage will cause cattle to lose teeth and to have an overgrowth of leg bones and ribs. Odor from a rendering plant or from some chemical plants can depress the value of land for both commercial and residential use. New York City estimates that corrosion costs the city about $6 million per year. Alternatives in sulfur dioxide control include the use of fuels with no sulfur, removal of the sulfur from the fuel, and removal from the gaseous products of combustion.

23022

Solntsev, S. S.

COMPUTATIONAL METHOD OF DETERMINING FLUORINE BALANCE DURING ALUMINUM ELECTROLYSIS. (Raschetnyy metod opredeleniya balansa ftora pri elektrolize alyuminiya). Text in Russian. Tsvetn. Metal., 40(2):59-62, 1967. 8 refs.

The following quasiempirical formulas for fluorine loss during electrolytic production of aluminum are presented: 1) loss with exhaust gases as a function of cryolite content of the electrolyte and electrolyte temperature; 2) loss with fettlings as a function of service interval; 3) loss in the form of CF4 as a function of the number of anode effects, duration of anode effect, and % yield in terms of current; 4) mechanical loss as a function of the fluoride content of the raw material; and 5) loss with the coal ash. Fluorine loss through exhaust gases is reported for three installations and ranges from 18.97 to 25.63

kg/t. It is estimated that cooling the process by 5 degrees C will reduce fluorine consumption by 0.2 kg/t, while increasing the cryolite ratio by 0.1 will affect approximately a 3 kg/t savings.

23561

Morgan, George B. and Guntis Ozolins

THE IMPACT OF AIR POLLUTION ON THE ENVIRONMENT. Preprint, National Air Pollution Control Administration, Cincinnati, Ohio, Div. of Air Quality and Emission Data, 12p., 1970.

The population of a large part of the world has been exposed to polluted air for many decades and, in some cases, centuries. Significant increases are forecast for the future. If control actions are not intensified, air pollution may increase by a factor of six to ten by the year 2000. Before any meaningful control efforts can be carried out, we must know what the ambient levels of pollution are and how they relate to levels established as causing health or economic effects. Many pollutants have always been a part of the natural atmosphere. They are now called pollutants because, with man's help, they are now excessive in quantity. Particulate pollution is the most recognized and pervasive. Its health effects are functions of both particle size and composition. Another significant effect is that, suspended in the atmosphere, particulates reflect away part of the sun's energy and could result in an over-all lowering of the earth's temperature. Gases, 90% of all pollutants, are the second class of pollutant. Examples are sulfur dioxide, nitric oxide, nitrogen dioxide, carbon monoxide, and hydrogen fluoride. A third major pollutant class is the family of hydrocarbons. These participate in photochemical reactions which result in the formation of secondary pollutants such as peroxyacyl nitrates, ozone, formaldehyde, other aldehydes, and ketones. It is from these secondary pollutants that the primary danger to both animal (including the human animal) and vegetable life arises. Numerous industrial processes and the ubiquitous automobile emit these assorted products that are a serious problem in the environment surrounding their source. Almost all human activity results in some form of air pollution, direct or indirect, particulate or gaseous. High-temperature combustion, automotive, industrial, and domestic, is the principal offender. Parameters that must be considered when evaluating effects of pollution include quantity, distribution, and environmental tolerance for pollutants, individually and in concert. Locally, micrometeorology and topography also require consideration. Of all identified pollutants, suspended particulates and sulfur dioxide have been the most extensively measured and studied. As analytical techniques become available, other pollutants will come under programmed surveillance. Among these are asbestos, mercury, lead, pesticides, fluorides, and biologically active metals. International assessment of these problems is necessary for the preservation of the biosphere.

23865

Mammarella, Luigi

EVALUATION OF POLLUTION EMISSIONS IN ITALY. (Valutazione delle effluenze inquinanti in Italia). Text in Italian. In: L'inquinamento atmosferico in Italia. Rept. 27, p. 70-95, 1970. 110 refs.

An attempt is made to estimate the development of the pollution problem in the near future on the basis of current statistics. Figures are given on the responsibility of the main sources of pollution for the various types of pollutants found in the atmosphere. The emission of materials related to air pollution is given for six of the main industrial sources and for 4 types of fuel used. Meteorological conditions are summarized for 7 important areas of Italy: Turin, Milan, Venice, Bologna, Rome, Naples and Taranto. This is correlated with the consumption of fuel oil and gasoline, and a hypothesis is worked out for predicting possible pollution levels up to the year 1980. It is estimated that in the period 1970-1980, one could expect an average annual increase for all types of pollutants of 6.7%.

24039

Drinker, Philip

AIR POLLUTION PROBLEMS IN THE UNITED STATES. World Health Organization, Copenhagen (Denmark), Regional Office for Europe, Proc. Conf. Public Health Aspects Air Pollution Europe, Milan, Italy, 1957, p. 21-36. 11 refs. (Nov. 6-14.)

As in other countries, the demand for power in the U. S. is increasing steadily, at an estimated 3% annually. Bituminous coal is still the most used fuel, followed in order by oil and gas. Some of the coals used in the mid- and far-west have a sulfur content as high as 5%; thus some very large power stations emit sulfur dioxide in amounts comparable to those from smelters roasting sulfide ores. There is a general rule in the U. S. requiring power stations that burn coal in powdered form to clean their stack effluents of grit and ash before discharge. It is also common practice to make an extensive meteorological survey before building a tall chimney, to insure an adequate height for dispersion of smoke plumes. Pollution from ore smelters, by fluorides, and from vehicle exhausts, with emphasis on smog effects is discussed. Attention has not been paid to date to nitrogen oxides in chimney gases; these concentrations increase with furnace temperatures, so that the better the plant is run the more oxides of nitorgen are given off. Although the technology for control of the more well known pollutants has made considerable progress, no practical method has yet been devised for control of nitrogen oxides.

24370

Stuewe, A. Howard

HYDROGEN FLUORIDE: WHERE IT GOES, HOW IT'S MADE, WHY IT'S GROWING. Chem. Eng. News., vol. 36:34-38, 57, Dec. 22, 1958.

Consumption of hydrogen fluoride is expected to reach 215,000 tons in 1963. Grouped under four major categories, the principal market for HF are primary aluminum production, fluorocarbons (refrigerants aerosols), uranium production, and petroleum alkylation (in the production of high octane blending components for gasoline). All HF production is dependent on the reaction of sulfuric acid with fluorspar, domestic reserves of which could become exhausted by the end of the century. Fractional distillation is employed to remove high-boiling impurities (sulfuric acid and water) and lower-boiling impurities (silicon tetrafluoride, carbon dioxide, and sulfur dioxide) from HF.

25305

Graaf, H. de and J. W. Tesch

AIR POLLUTION IN AN AREA OF RAPID INDUSTRIALIZATION. World Health Organization, Copenhagen (Denmark), Regional Office for Europe Proc. Public Health Aspects Air Pollution Europe, Milan, Italy, 1957, p. 208-218. 3 refs. (Nov. 6-14.)

Complaints about air pollution in Rotterdam led to the establishmen of the Rotterdam Soil, Water and Air Committee with special subgroups to investigate emissions from fluoride-producing industries, incinerator plants, oil refineries, smoke-producing installations, and small industries and restaurants. Each group advises management about the possible hazards

posed by emissions and suggests appropriate control measures. Other activities of the Committee include regular pollutant measurements, rainwater analyses, twice weekly air sampling, hourly smoke sampling, mortality studies, clinical studies of patients with chronic bronchitis, and examinations of diseased cattle and damaged vegetation. Despite measures of eliminate fluorides from stack gases, their presence in even small concentrations is harmful to plants. Since rain-gauge samples near two phosphate plants contained less fluorides than samples collected in the center of Rotterdam, the presence of another source of fluoride pollution is suspected. Investigations are under way to determine if it is the coal used by power plants and several industries.

26136

Tauda, F.

PRESENT SITUATION AND OUTLOOK OF FLUORIDES AIR POLLUTION PREVENTION TECHNOLOGY--TACKLING WITH ALUMINUM SMELTING POLLUTION. (Fukkabutsu ni yoru taiki osen boshi gijutsu no genjo to tenbo - arumi seiren kogai ni torikumu). Text in Japanese. Kinzoku (Metals) (Tokyo), 41(1):122-125, Jan. 1 and 15, 1971. 9 refs.

Sources of fluoride pollution and the effects of fluorides on man and plants are reviewed. Aluminum electrolysis uses cryolite which is 54% fluoride. Raw materials containing fluorides are also used in the production of phosphate fertilizers and iron and steel. Raw materials containing smaller amounts of fluorides are required for the production of glass fibers, bricks, tiles, cement, and porcelain. Coal burned by thermal power stations can be a problem since coals contain 20-295 ppm of fluorides, averaging 120 ppm. Fluorides affect plants more than any other atmospheric pollutant, accumulating in a large number of species in polluted areas. Fluorides affect man in two ways, directly through air pollution or indirectly through contaminated vegetation. They are present in considerable amounts in both green vegetables and rice. Symptoms of chronic fluoride poisoning in man are abnormal hardening of bones and spots on teeth. Cases of chronic poisoning have appeared among workers exposed to cryolite dust and among individuals whose drinking water contains more than 6 ppm fluorides Existing technology, the use of scrubbers for controlling fluoride emissions from aluminum electrolysis or electric furnaces, is effective only with concentrations up to 1 ppm. New production technologies should be developed which dispense with the use of raw materials containing fluorides.

26254

Perrine, Richard L. and Limin Hsueh

MISCELLANEOUS INDUSTRIAL EMISSIONS. In: Project Clean Air. California, Univ., Berkeley, Task Force 5, Vol. 1, Section 14, 5p., Sept. 1, 1970. 3 refs.

Five broad categories of industrial polluters are briefly considered, as well as their kinds of emissions and control problems. The inorganic chemical industry has problems with hydrochloric acid, hydrofluoric acid, nitric acid, sulfuric acid, calcium oxide, chlorine, soaps and detergents. Steel production is a major industry, but the open hearth furnaces are gradually being replaced by the basic oxygen furnace. Although this also produces fumes, the new plants can be constructed with proper control equipment. Foundries may change the work they do from day to day so that control problems are at their worst, but methods to trap particles and fumes are available. The handling of large volumes of minerals normally involves problems with dust, while the special biological effects of asbestos must be noted. Glass fibers can also be a problem, as well as fluoride-containing ores. Copper lead, and zinc mining and milling operations involve dust problems, while sulfur oxides may be released during smelting. Hydrogen sulfide, mercaptans, sulfide and polysulfides which have very bad odors, and other noxious gases are emitted during wood pulp processing. Typical gaseous emissions from Kraft pulping are presented tabularly. Coffee roasting plants, slaughterhouses, and pickel plants emit strong odors. An areas of concern is new processes to break down waste and return it to a state useful in natural processes without problems of storage. A particularly important point which needs to be considered is site location.

26258

Williams, Charles R.

AIR POLLUTION FROM FLUORIDES. J. Air Pollution Control Assoc., 6(2):100-102, Aug. 1956. (Presented at the Air Pollution Control Association, 49th Annual Meeting, Buffalo, May 20-24, 1956.)

There has been a long history in the country of severe crop and cattle damage in several areas caused by air pollution from fluorides. Rock phosphate and fluorspar and other ores of fluorine compounds are the major sources responsible for this pollution problem. A brief review of production figures for these materials defines the extent of the problem. Phosphate rock is utilized primarily for the production of superphosphates (fertilizers), food and medicinal phosphates, elemental phosphorus, phosphoric acid, ferro-phosphorus, and stock and poultry feed. The important sources are in Florida, Tennessee, Idaho, Montana, Utah, and Wyoming. Utilization of fluorides, particularly in production of aluminum and steel, provides another large-scale source of fluoride pollution. The use of fluorides in the production of aluminum is discussed, as well as the release of fluoride in the production of elemental phosphorus and superphosphates.

26329

Khnygin, V. L. and R. A. Shamsudinova

ATMOSPHERIC POLLUTION IN A SUPERPHOSPHATE PLANT. (Zagryazneniye atmosfernogo vozdukha superfosfatnym zavodom). Text in Russian. Gigiena i Sanit., no. 10:85-87, 1970. 2 refs.

Air pollution from a fertilizer plant with a total daily emission of 0.36-1.08 tons of phosphorus compounds, 1.85-2.59 tons of ammonia, 10-17 tons of sulfur oxides, and 20-34 tons of nitrogen oxides was studied. The sulfuric acid plant has a 100-meter stack and the superphosphate plant, a 40-meter stack; both are equipped with electrofilters. A 1967 survey revealed that school children living in the vicinity of this plant showed increased incidence of fluorosis as a result of exposure to hydrogen fluroide emissions which reached levels as high as 3 mg/cu m. Reduced yields from fruit trees, grape vines, and other plantings within a 500-meter radius were also reported.

27314

Steel, J.

RESPIRATORY HAZARDS IN SHIPBUILDING AND SHIPREPAIRING. Ann. Occupational Hyg. (London), vol. 11:115-121, 1968. (Presented at the 22nd Conference of the British Occupational Hygiene Society, Newcastle upon Tyne, Sept. 1967.)

The potential respiratory hazards associated with welding and flame-cutting processes carried out in shipyards are listed. To differentiate between real and apparent hazards, the mean concentrations of toxic substances measured in 40 investiga-

tions are compared with the corresponding Threshold Limit Value. The results make it clear that zinc and iron fumes are general hazards; nitrogen dioxide is a severe hazard in enclosed flame-cutting processes; copper, vanadium, and fluoride fumes are likely hazards in welding; and sulfur dioxide and ozone are hazards in specific processes. Workers should be protected against these substances by both general and local exhaust ventilation. Where local exhaust ventilation is not possible, operators should be equipped with positive pressure-air line respirators.

27595

Carroll, Robert E.

TRACE ELEMENT POLLUTION OF AIR. Missouri Univ., Columbia, Environmental Health Center and Missouri Univ., Columbia, Extension Div., Proc. Missouri Univ. Third Annu. Conf. Trace Substances Environ. Health, Columbia, Mo., 1969, p. 227-231. 6 refs. (June 24-26.)

Trace elements constituting a present or potential community health hazard include lead, cadmium, beryllium, barium, nickel, and fluorides. As a contaminant from motor vehicle fuel, lead is known to be present in amounts sufficient to raise the body burden. Cadmium has been linked to hypertensive diseases, and high air levels seem to be correlated with increased mortality. Beryllium is recognized as a serious industrial hazard that can produce disease at very low concentrations. Because of its use in rocket and missile fuels, community beryllium levels must also be carefully monitored. Barium has become a community concern because of its increasing use as a motor vehicle and diesel fuel additive. No health effects have been demonstrated from current nickel levels, but further research is needed. Excess fluoride in air may pose regional problems involving contamination of animal forage or plant damage. A major problem in evaluating trace elements is that very little is known about the ecological cycles from air-to-food chains and water supplies. (Author abstract modified)

27617

Stockham, John D.

THE COMPOSITION OF GLASS FURNACE EMISSIONS. Preprint, Air Pollution Control Assoc., Pittsburgh, Pa., 30p., 1970. 4 refs. (Presented at the Air Pollution Control Association, Annual Meeting 63rd, St. Louis, Mo., June 14-18, 1970, Paper 70-72.)

The concentrations of sulfur oxides, nitrogen oxides, fluorine, chlorine, and carbon monoxide from two furnaces, one melting flint glass and the other melting amber glass, were determined either by adsorption on silica gel impregnations or by scrubbing the gases in liquid impingers, while grain loading of particulate matter was determined by filtering a sample of the effluent and weighing the collected material. The volume of effluent discharged was determined from velocity data obtained by a pitot tube traverse across a stack diameter. Solids loadings averaged 2.1 and 5.4 lbs/hr or 0.029 and 0.041 grains/scfm of exhaust gas for the flint and amber glass emissions, respectively. SO3 averaged 17 and 15 ppm, by volume, while the SO2 concentrations averaged 250 and 315 ppm. F and Cl concentrations were about 2 and 4 ppm, respectively. Nitrogen oxides concentration averaged 340 and 640 ppm. CO content in the flint glass effluent was 375 ppm and in the amber glass effluent, 40 ppm. Particle size, shape, and composition were determined using electron microscopic and spectroscopic techniques. The geometric median particle diameter, based on a size-frequency distribution by number, was about 0.12 micron. Three forms of sodium sulfate were identified; other elements identified as being present in major proportions were calcium, magnesium, silicon, barium, and chromium. (Author abstract modified)

27930

Roe, J. W.

GASES AND FUMES PRODUCED IN FUSION WELDING AND CUTTING. Ann. Occupational Hyg., vol. 2:75-84, 1959. 16 refs.

What is known about the nature and amount of fumes and gases evolved from oxyacetylene welding, arc welding, oxygas cutting, and arc cutting is summarized. Arc welding presents the greatest range of possible toxic by-products, with the nature of the fumes and gases evolved depending to a large extent upon the means adopte to protect the molten weld from the atmosphere. Thus, when the electrode consists of a bare steel rod, the fume consists of iron oxide with more or less manganese oxide; nitrogen oxides are also formed from the air as a result of the high temperature and the ultraviolet radiation from the arc. For a given type and size of electrode, the total weight of fume evolved depends upon the rate at which it is melted down (i.e. upon the current). The quantity o nitrogen oxides and ozone produced depend upon the energy dissipated in the arc and upon the degre: of its exposure; thus deep penetration welding and welding with a bare electrode produce larger quantities while the so-called 'dead soft' electrodes, in which the end of the rod is in a cup formed by the unmelted coating produce less than average. Types of electrodes, constituents of the coating, and notes on the fumes evolved are presented tabularly Small quantities of gaseous fluorine compounds are evolved during the normal use of low hydrogen electrodes and these quantities become appreciable if abnormally high welding currents are employed. The rate of production of nitrogen oxides is mentioned, including their toxicity. Submerged arc welding and the fumes which may be evolved are also indicated. Fumes formed from inert gas shielded welding are cited. The vapor of trichlorethylene yields phosgene both directly as a result of photochemical decomposition and indirectly by reaction with ozone. Maximum allowable concentrations and the control of nitrogen oxides, fumes, and ozone are discussed. Good ventilation is indicated.

28038

Johnstone, H. F.

PROPERTIES AND BEHAVIOR OF AIR CONTAMINANTS. Ind. Med. Surg., 19(3):107-115, March 1950. 19 refs.

Some of the obnoxious gases known to be present in industrial atmospheres and their physiogogical effects observed at low concentrations are described, and their threshold values indicated. Chief sources of sulfur dioxide in industrial cities are the combustion of fuels, smelting operations, refineries, and chemical plants. SO2 in the air is known to be injurious to vegetation above 0.5 ppm, to contribute extensively to the corrosion of buildings and metal objects, and to cause irritation of the throat at 10 ppm. Hydrogen sulfide is one of the constituents of the waste gases from pulp mills, and is prevalent around sewage disposa plants, gas plants, and mine seepages. It rapidly discolors lead paints. Sources and effects of sulfur trioxide or sulfuric acid mist and other sulfur compounds are also indicated. The principal methods for treating gases containing SO2 are absorption in a liquid absorbent followed by regeneration by heating, neutralization with ammonia and recovery of ammonium sulfate, neutralization by lime slurry, absorption in water or aqueous solutions, and recovery of hydrogen sulfide. Formation of the oxides of nitrogen and its control are mentioned; as well as ammonia. Hydrogen fluoride may be produced from aluminum plants and phosphate fertil-

izer plants, and causes irritation of the throat, coughing, fluorosis in cattle, and mottled teeth in man. Sources and effects are included for hydrogen chloride, organic chlorides, carbon dioxide and monoxide, exhaust gases, peroxides, and zone. Optical properties of aerosols and their effect on visibility are discussed, as well as their deposition, coagulation, stability, diffusion in the atmosphere, electrostatic properties, and physiological effects. In many ways the physical properties of aerosols are more important in atmospheric pollution than the chemical nature of their constituents.

28282

Schuursma, M. J. N.

FLUORINE POISONING RESULTING FROM THE AIR POLLUTION CREATED BY A SUPERPHOSPHATE PLANT. (Fluoorvergiftiging tengevolge van luchtverontreiniging door een superphosphaatfabriek). Text in Dutch. Chem. Weekblad, 38:583-584, 1941. 4 refs.

A complaint made to the public health agency that window panes in buildings located near a superphosphate plant were strongly etched indicated the presence of hydrogen fluoride in the atmosphere, which was traceable to the high content (3%) of fluorine compounds in the raw phosphate used at the plant. For a number of years there had been technical knowledge of wet processes by which the HF gas could be recovered and used in the manufacture of sodium fluorosilicate, a highly marketable byproduct. It was found that while the phosphate used as raw material contained 3% fluorine, the superphosphate product contained only 1%. Two rainwater sampling stations were set up, on 100 m from the plant, the other 300 m, and the chemical composition of the samples from these two locations were compared with that of a study made elsewhere. This comparison revealed a relatively high concentration of chloride, nitrate, calcium, and phosphate ions, as well as a 2.0% content of fluoride ions at the 100 m station, and 1.3% at 300 m. The study further demonstrated that milk poisoning, traceable to dairy animals who were pastured in the vicinity of the plant, could be derived from this excessive concentration of fluorine in the atmosphere. Earlier complaints of milk poisoning had been attributed to pollution from sulfur dioxide and nitrogen compounds, and to a fine dust that was emitted from the plant.

28652

Takada, N., Shozo Matsuda, Masamichi Hara, Daihachiro Koyama, and Yoshihiro Nakagawa

EFFECTS OF FLUORIDE EMISSIONS FROM ROOF-TILE-KILN ON PLANTS. (Uwagusurigawara seizo kojo haigasuchu fusso kagobutsu ni yoru shokubutsu haigai ni tsuite). Text in Japanese. Taiki Osen Kenkyu (J. Japan Soc. Air Pollution), 5(1):226, 1970. (Proceedings of the Japan Society of Air Pollution, Annual Meeting, 11th, 1970.)

Two ceramic plants which manufacture glazed shingles were investigated for fluoride emissions that were suspected of causing damages to agricultural products in the neighborhood. The items investigated were the original shingle material before glazing and firing and the exhaust gas from the kiln. In one plant, 1.7 to 4.1 ppm of fluorides were determined in the exhaust gas, and 3.0 to 4.4 ppm were found for the emissions from the other plant. Fluorides in air were measured by the JIS K 0105 method; from one plant, 20 ppb were recorded 210 m downwind. For the other plant, 43 ppb were discovered 73 m downwind. Further measurements were taken at six locations in a fan-shaped area downwind from the plant in the main wind direction, and 258 micrograms F(-)/100 sq cu/30 days were found 140 m southwest of the plants. The concentrations decreased with the distance from the source. When plants were analyzed, significantly larger amounts of fluorine were seen compared to those plants that were not damaged.

29519

Schwarz, Karl

THE INFLUENCE OF ENVIRONMENTAL PROTECTION ON PLANNING, OPERATION AND ECONOMY OF STEAM POWER PLANTS. I. MAINTENANCE OF CLEAN AIR. (Einfluss des Nachbarschutzes auf Planung, Betrieb und Wirtschaftlichkeit von Dampfkraftwerken. Teil 1: Reinhaltung der Luft). Text in German. Tech. Ueberwach. (Duesseldorf), 12(4):106-112, April 1971. 29 refs.

Steam power plants emit solid matter such as fly ash and soot, and gases such as sulfur and nitrogen oxides, hydrocarbons, and fluorine compounds. The VDI guideline 2091 limits dust emissions of power plants with a capacity of 70,000 cu m/hr to 150 mg/cu m dry flue gas volume. Only electrostatic precipitators achieve this value in the cleaned gas. For heavy fuel oil, soot emissions are limited to a smoke shade 3, which is to be measured by the Bacharach filter paper method. The VDI commission has worked out a limit value for soot according to which not more than 70 mg soot may be emitted/cu m solid matter (oil, coke, etc.). During soot blowing, not more than 200 mg/cu m may be emitted. Over the entire operating period, not more than 1.5 g soot/kg oil may be emitted on the average. For soot collection, centrifugal separators are widely used. Of the gaseous pollutants from steam plants, sulfur dioxide is the most important. Since no efficient flue in gas desulfurization process is yet available, efforts are under way to obtain low-sulfur fuel oils. No measurements have yet been taken of the gaseous fluorine compounds emitted by steam boiler plants. It is assumed that most of the fluorine is bound to alkaline ash components. The nitrogen dioxide emission has been limited to a long-term maximum allowable concentration of 1 mg/cu m. Cooling towers 100 m high and more are emitters of droplets which contaminate the environment. In some power plants, droplet separators have been installed with great success.

29532

Koizumi, Mutsuo

AIR POLLUTANTS GENERATED IN INTRA-FURNACE COMBUSTION. (Ronai nensh ni okeru taikiosen busshitsu no hassei). Text in Japanese. Japan Society of Mechanical Engineering, Tokyo, Proc. Special Symp. Air Pollution, 27th, 1971, p. 23-42. (April.)

The generation mechanism of air pollutants formed during the intra-furnace combustion of solid, liquid, and gaseous fuels was discussed with respect to the type of combustion equipment and othe conditions. Dust containing unburned carbon is emitted as a result of solid fuel combustion, when combustion gas is used for heating, and by the combustion of liquid and gaseous fuels. Most of the sulfur content in fuel becomes sulfur dioxide during combustion. Part of the sulfur contained in the fuel is oxidized to form sulfur trioxide which, combined with water, often becomes sulfuric acid mist. The SO2 in the emission gas sometimes changes to form SO3 through atmospheric oxidation. When the combustion gas allows the formation of sulfuric acid, it causes the soot in the gas to condense into masses. These masses of soot fall onto neighboring areas. The nitrogen oxides discharged from an intra-furnace combustion device are usually nitric oxide and nitrogen dioxide. The NO is first generated during combustion and is partially transformed to NO2 as it goes through the furnace and heating device. In some combustion devices such as a cupola or diffusion flame annealing furnace which require a reducing

atmosphere, the exhaust gas contains carbon monoxide and hydrogen. An incinerator discharges aluminum, aldehyde, and organic acid if the combustion temperature is not high enough. Hydrogen chloride is generated from the incineration of vinyl chloride, hydrogen fluoride from the incineration of fluorine resins or from tank furnaces of special glass, and metal compounds from the combustion accompanying metal processing or from incineration of plastics-containing additives.

29786

Becker, Karl H.

PHYSICAL-CHEMICAL PROBLEMS OF AIR POLLUTION. (Physikalisch- chemische probleme der Luftverunreinigung). Text in German. Chem. Unserer Zeit., 5(1):9-18, Feb. 1971. 46 refs.

Principal air pollutants are reviewed. Carbon monoxide is generated by the incomplete combustion of fossil fuels, for instance in an automobile engine which emits 0.5 to one ton of carbon monoxide per automobile per year. Since CO is converted to the harmless carbon dioxide at elevated temperatures only, it can stay in the atmosphere for two to three years. Sulfur dioxide is produced when heavy fuel oils and coal, containing sulfur in various concentrations are burned. When in the air, sulfur dioxide is oxidized to sulfur trioxide, which can combine with water vapor to form sulfuric acid and can cause the formation of smog which disappears from the atmosphere with rain. Hydrocarbons are emitted by petrochemical industrial plants and are also components of automobile exhausts. Automobile exhausts also emit nitric oxide and nitrogen dioxide. Halides as pollutants usually occur in small concentrations, except in some areas of steel and aluminum producing plants where greater concentrations of hydrochloric and hydrofluoric acids may occur. The incineration of scrap synthetic materials, such as polyvinyl chloride and teflon also cause pollution from the chlorine and fluorine compounds. Other pollutants mentioned are carcinogens such as benzpyrene and other polycyclic hydrocarbons contained in the soot emitted by diesel engines and lead compounds present in automobile exhaust gases, if gasoline containing tetraethyl lead as antiknock agent is used.

30218

Tichatschke, J.

STUDIES OF THE EMISSIONS FROM REFUSE INCINERATORS. (Untersuchungen ueber Emissionen aus Muellverbrennungsanlagen). Text in German. Mitt. Ver. Grosskesselbesitzer, 51(3)219-223, June 1971. (Presented at the VGB - Fachtagung Muellverbrennung 1970, Salzburg, Austria Aug. 28, 1970, Hamburg, West Germany, Sept. 11, 1970, and Koln, West Germany, Sept. 25, 1970.)

In an experimental refuse combustion furnace, with a throughput of 20 t/hr at a heating value of 1600 kcal/kg, measurements of the gaseous emissions were taken over a three year period with an electrically heated quartz probe and a subsequent electrically heated quartz wool filter. The sampling point was at the boiler end after the economizer. The waste gas temperature at this point was 220 C. For determination of sulfur trioxide, absorption in 80% isopropanol and photometric methods were used. Sulfur dioxide was absorbed in an iodine solution. Prior to this method, the gravimetric method was used. The chloride content of the flue gases was determined with the mercury(II)-oxide-cyanide method. For this purpose, 50 to 100 liters of flue gas were drawn through a scrubber. For hydrogen fluoride measurements 500 liters of flue gas were drawn through a fritted gas scrubber. Diluted sodium lye was used as absorption solution. The volatile organic acids and aldehydes were also determined. The hydrogen chloride, hydrogen fluoride, and sulfur dioxide concentrations rose gradually over the years. For HCl, a maximum concentration of 18 mg/cu m was measured. For SO2, the frequency maximum ranged from 0.8 to one g/cu m. The most frequently measured SO3 concentration was 0.03 g/cu m. For CH3COOH, a maximum concentratio of 120 mg was measured, and for HCHO, of 200 mg/cu m. The ammonia content, which was measured over a period of two years, ranged from 0.5 to 4.5 mg/cu m. No hydrogen sulfide, chlorine, or phosgene could be detected. The odor of the gases became more pronounced as the temperatures dropped to below 650 C. Rain water samples taken just beneath the smoke plume from an incinerator revealed that the rain is influenced by the waste gas, but is not a concentrated acid.

30296

Teworte, W.

THE USE OF FLUORINE-BEARING MATERIALS IN THE GERMAN FEDERAL REPUBLIC. (Einsatz von fluorhaltigen Materialien in der BRD). Text in German. VDI (Ver. Deut. Ingr.) Ber., no. 164:11-18, 1971. 13 refs.

Before World War II, Germany was the world s largest supplier of fluorine. In 1938, it produced 30% or 140,000 tons out of a total world production of 462,000 tons. Since then, the situation has changed completely. In 1969, the world consumption amounted to about 3.6 million tons, out of which Mexico as the largest producer provided one million tons; Germany s participation was only 90 000 tons which placed it eighth after Mexico. This latter production was practically used up completely by the domestic industry; in addition, some 160,000 tons were imported to cover the overall demand of 250,000 tons. Of the world s consumption of fluorine in 1969, 45% were used for steel manufacturing, 15% for aluminum, 33% for producing chemicals, and 7% for glass and ceramics. The chemical industry requires fluorite, CaF2, primarily for producing hydrofluoric acid, HF. Two tons of CaF2 are needed for producing one ton of HF. Hydrofluoric acid in turn is used as an intermediate product for the manufacture of numerous inorganic and organic fluorine compounds. Among the inorganic compounds are aluminum fluorides, used as flux material in the production of primary aluminum. The organic fluorine compounds include the aliphatic chlorine-fluorine-hydrocarbons, such as freon, which are used as spraying and cooling substances. Other important fluorine- bearing products are synthetic materials, such as teflon. Direct applications for fluorspar can be found in the manufacture of steel, of welding electrodes, enamel, glass wool, and other industrial products.

30447

Nelson, Kenneth W.

NONFERROUS METALLURGICAL OPERATIONS. In: Air Pollution. Arthur C. Stern (ed.), Vol. 3, 2nd ed., New York, Academic Press, 1968, Chapt. 37, p. 171-190. 16 refs.

While sulfur dioxide from the smelting of copper, lead, and zinc has been the principal pollutant of interest in nonferrous metallurgy, gaseous and particulate fluorides from aluminum smelting are also of concern. Fluoride problems first came to attention because of adverse effects on grazing animals rather than effects on vegetation, as with SO2. The mining, milling, and concentrating of copper, lead, and zinc are discussed, as well as their refining and smelting, emissions, and controls. The mining and ore treatment of aluminum is considered, its electrolysis, and emissions and controls. Copper, lead, zinc, and aluminum produced from scrap are also discussed. The production of nonferrous alloys is noted.

30517

Baiulescu, G. and P. Marcuja

ASPECTS REGARDING THE STUDIES ON AIR POLLUTION. (Aspecte referitoare la studille asupra poluarii atmosferei). Text in Rumanian. Rev. Chim., 22(1):51-55, Jan. 1971. 19 refs.

A general review is given of the subject of air pollution. A list of 10 major pollution sources is given, figures on the emission of specific substances by the various sources, a general review of inorganic and organic pollutants, methods of determining the major pollutants (including automated systems), and efforts to set standards and establish legislative controls. The following are some of the data given on emissions from specific sources. Ammonia plants emit about 90.7 grams of ammonia and 90 kg of carbon monoxide per ton of ammonia produced. Chlorine plants give off 45.3-544 kg of chlorine gas per 100 tons of liquid chlorine produced. Hydrochloric acid plants emit organic chlorine compounds at the rate of 0.5 vol% of exhaust gases. The manufacture of nitric acid is responsible for about 27 kg of nitrogen dioxide per ton of acid, with an effective recovery of 36-99.8%, depending on the process used. Phosphoric acid plants emit 9-27 kg of silicon tetrafluoride and hydrofluoric acid per ton of phosphorus pentoxide produced, and emits 0.09-4.5 kg of pentoxide aerosol for each ton of acid produced. The manufacture of sulphuric acid results in emissions of 9-31.5 kg SO2 and 0.09-0.9 kg SO3 per ton, depending on the type of control equipment used. This type of data is given for a large number of pollution sources.

31134

Luxon, S. G.

FLUORIDE EMISSION DURING FIRING OF POTTERY IN CONTINUOUS KILNS. Fluoride, 3(2):61-65, April 1971.

In the manufacture of pottery with continuous kilns, the windows of the building and of some adjoining buildings were noticed to have become etched and no longer transparent due to the formation of ammoinumsilicofluoride. The calcium fluoride which is in china-stone was converted in the presence of organic matter into ammonium fluosilicate. Acid gases, arising from products of combustion used to heat the kiln, liberated hydrofluoric acid which accounts for the etching of glass. Air samples in the kiln workroom showed fluoride concentrations up to 3.5 mg/cu m. (Author abstract modified)

31144

Hasegawa, Toshio

AIR POLLUTION PROBLEMS OF A GLASSWORKS. (Garasu kojo no kogai mondai). Text in Japanese. Kagaku to Kogyo (Tokyo) (Chem. Chem. Ind.), 45(2):28-35, 1971.

The main air pollutant discharged from glassworks is smoke dust, the main source of which is the cubicle furnace. The results of surveys made at two glass factories for dust emission and at another glass factory suspected of emitting noxious gas damaging to crops are discussed. The two factories surveyed for dust emission were a physical and chemical glasswares manufacturing firm and a vacuum bottle manufacturing firm. In the former, four 500 lb. cubicle furnaces with a maximum fuel consumption of 35 l/hr and a normal consumption of 26 l/hr, a 1.7 cu m combustion chamber, and rotary-type burners using B heavy oil were inspected. The dust density was 1.21 g/N cu m at maximum, 0.13 g/N cu m at minimum, and 0.46 g/N cu m on the average. In the second factory, eight 750 lb cubicle furnaces were surveyed. The ratings included the fuel consumption, 62.6 l/hr of B heavy oil, and the 1.94 cu m combustion chamber. The dust density was 1.24 g/N cu m at maximum, 0.12 g/N cu m at minimum, and 0.66 g/N cu m on the average. Crop damage had been reported in the vicinity of a glassworks manufacturing fancy bottles. An investigation was conducted to determine the cause. It was a fluorine compound, such as hydrogen fluoride, generated during the processing of fluorite. The damage to the crops included foliar burns or dead leaves in rice plants on a long, narrow strip of land in the 20-300 m range west of the factory. Soybeans in the area were most seriously damaged, suffering from chlorosis. The total acreage of damage amounted to 20 acres of rice plants and 15 acres of soybean. Sampling and measurement of the noxious gas at the source in the atmosphere, and in rainfalls, and chemical analysis of the damaged crops were conducted. The results of the measurement and analysis are shown in tables and charts. Fluorine, detected from the crust of soy bean, amounted to 299.2 ppm at the nearest point from the factory, while that detected from the rice-bran was 26.4 ppm at the point farther than the first point and 6.0 ppm at the farthest point.

31283

Birse, E. A. B.

PROBLEMS IN ALUMINIUM REFINING. Smokeless Air (London), 40(151): 19-22, Autumn 1969. (Presented at the Scottish Division, Annual Conference, Largs, Great Britain, May 22, 1969.)

Aluminum is smelted by dissolving alumina in molten cryolite (sodium aluminum fluoride) and passing an electric current from a carbon electrode (anode), which is suspended in the molten solution, to the carbon lining of the containing pot (cathode). The process itself does not evolve fluorides; but when fluoride additions are made to the molten cryolite, fluoride vapors escape to the ambient air above the pot. Total fluoride losses from a large pot are only 23-35 lb/24 hr, but in a modern smelter with 340 pots the overall emission is significant. New smelters are achieving 95% fume collection by enclosing pots within hoods and by using electrolytic pots with prebaked instead of self-baking anodes.

31315

Strunz, W.

CHEMISTRY AND ENVIRONMENTAL HYGIENE. (Chemie und Umwelthygiene). Text in German. Allgem. Prak. Chem. (Vienna), 22(2):25-31, Feb. 1971. (Presented at the Bundesinnungstagung des chemischen Gewerbes, Wien, West Germany, Oct. 23, 1970.)

There are 300 chemical substances which are termed air pollutants. Some of the most common air pollutants are sulfur dioxide, sulfur trioxide, hydrogen fluoride, fluorine, chlorine, nitrogen oxides, aldehydes, ketones, lead, hydrogen chloride, carbon dioxide, and carbon monoxide and tetraethyl lead. Among the heaviest polluters are power plants. In a thermal power plant with a capacity of 300,000 kW/hr, 70 tons of oil are burned and one million cu m flue gases are produced. The rain water in industrial centers has, at times, a pH of five. Automobiles are also heavy polluters. In Vienna, 90,000 tons of CO are emitted into the air/day. The emissions of hydrocarbons, lead, and SO2 are 9000, 0.55, and 180 tons respectively. The maximum allowable concentration for nitrogen oxides is one mg/cu m air, for Cl2 0.3 mg/cu m air, for hydrogen sulfide 0.15 mg/cu m, for SO2 0.40 mg/cu m, for lead 0.004 mg/cu m, for 0.1 mg lead/day. The atmospheric pollution affects humans, animals, and plants.

31333

Dreyhaupt, F. J.

CONCLUDING REMARKS. (Schlussbemerkungen). Text in German. VDI (Ver. Deut. Ingr.), Ber., no. 164:110-112, 1971.

No limit values on permissible fluorine concentration have been decided upon and released by the German Authorities. This is a matter of urgency, considering the fact that the phytotoxicity of fluorine is approximately 100 times greater than that of sulfur dioxide, and that fluorine emissions are steadily on the increase because new sources of emission continue to arise, for instance in ore sintering plants and aluminum works. Sufficient information is by now available to determine maximum permissible concentrations. Doubts have been expressed concerning whether the results of induced plant intoxication by fluorine gas in test enclosures are directly comparable with field conditions. More preliminary experimentation is not needed. Very conservative emission limits based on the results of the enclosure tests and on the various information available from international research are needed. Any regulations eventually issued should not be applicable on days of weather inversions.

31529

Carotti, Arrigo A. and Elmer R. Kaiser

CONCENTRATIONS OF 20 GASEOUS CHEMICAL SPECIES IN THE FLUE GAS OF A MUNICIPAL INCINERATOR. Preprint, Air Pollution Control Assoc., Pittsburgh, Pa., 25p., 1971. 5 refs. (Presented at the Air Pollution Control Association Annual Meeting, 64th, Atlantic City, N. J., June 27-July 2, 1971, Paper 71-67.)

Tests were undertaken at the incinerator plant of the Town of Babylon, Long Island, to determine the physical composition of the emitted pollutants. Nitrogen dioxide was collected in evacuated flasks of known volume and measured spectrophotometrically via the reaction with the Griess-Saltzman reagent. Acid gases and mists were collected in appropriate impingers containing aqueous alkali, and each species conventionally quantitated according to accepted methods of appropriate sensitivity. Aldehydes and ketones were quantitatively absorbed in sodium bisulfite and quantitated iodimetrically. Sulfur dioxide was collected in hydrogen peroxide and determined as the sulfate. Hydrocarbons and phosgene were quantitated gas chromatographically. On the basis of the data recorded, hydrochloric acid is a major constituent of municipal incinerator gaseous emissions. The variations in the concentrations of the most predominant chemical species (HCl, NOx, SO2, organic acids) normally found in municipal incinerator emissions are significant and are probably the result of variations in the composition of the fuel charge. Hydrocarbons (C1-C5), cyanide, fluoride, phosphate, aldehydes, and chlorine are relatively minor constituents of municipal incinerator gaseous emissions. Water scrubbing appears to be effective in removing chlorides from flue gas. (Author abstract modified)

31581

Sholtes, R. S. and B. S. Tatera

PARAMETERS WHICH INFLUENCE FLUORIDE EMISSIONS FROM GYPSUM PONDS. Preprint, Air Pollution Control Assoc., Pittsburgh, Pa., 43p., 1971. 19 refs. (Presented at the Air Pollution Control Association, Annual Meeting, 64th, Atlantic City, N. J., June 27-July 2, 1971, Paper 71-19.)

The suspicion that gypsum ponds used in mineral mining and processing may be a major source of fluoride emissions is investigated. A laboratory based study examined the vapor pressure of gaseous fluoride in equilibrium with dilute solutions of hydrofluoric acid, fluosilicic acid, and mixtures of these and commercially obtained gypsum water. A modified gas saturation method produced samples that were analyzed for fluoride concentration by ion and reference electrodes. The effect of temperature, air velocity, and fluoride concentration on gaseous fluoride emissions from gypsum ponds were evaluated using a laboratory scale gypsum pond. Both gypsum slurry water and process water were examined. Measurements of air velocity were provided by a velometer and to types of anemometers. The relative humidity of the intake and exhaust air were measured by a sling psychrometer. The analysis gave a series of predictive equations for fluoride emission as a function of fluoride concentration, wind speed, water temperature, relative humidity, and evaporation rate. The vapor pressure studies predicted that for all solutions studied, HF gas would be the source of highest percentage fluoride in the saturated gas. They also showed that the fluorides present in gypsum water can act as if they were in equilibrium with fluosilicic acid. Laboratory gypsum pond studies revealed a buildup of fluorides in the gypsum water, which is not true for actual gypsum ponds, thus discounting fluoride emissions from the surface as the only means of releasing fluorides from gypsum ponds. Processes not occurring in the laboratory, i.e., percolation, rainfall dilution, and photochemical reaction, may therefore have a major part in preventing the buildup of fluorides in field gypsum ponds. Air velocity and temperature strongly influence fluoride emissions from gypsum slurry and process waters; the effects of concentration were relatively less. Charts and figures demonstrating the relationships are included.

31935

Nakamura, Keigo

ON AIR POLLUTION CAUSED BY HYDROGEN FLUORIDE. (Fukka suiso ni yoru taiki osen ni tsuite). Text in Japanese. Kogai To Taisaku (J. Pollution Control), 6(4):50-58, July 1971. 9 refs.

When the atmosphere contains as little as 10 ppb of hydrogen fluoride, crops can be damaged, because the HF is accumulated in the leaves. Teeth and bones are also affected when cattle eat feed containing 30-50 ppm HF over an extended period of time. Fluoride emissions are issued from plants which process ores containing fluoride compounds. Steel mills in Japan are using about four kg fluorspar/ton steel. Various types of scrubbers are utilized to recover fluoride from aluminum smelter and phosphorus fertilizer exhaust gases. Collectors are then used to trap fluoride and sulfuric acid mists.

32060

Chambers, Leslie A.

CLASSIFICATION AND EXTENT OF AIR POLLUTION PROBLEMS. In: Air Pollution. Arthur C. Stern (ed.), Vol. 1, 2nd ed., New York, Academic Press, 1968, Chapt. 1, p. 1-21.

This history of air pollution is discussed, including natural causes, decaying refuse, and wood smoke. The use of coal from the beginning of the 14th century to the early part of the 20th led to air pollution by coal smoke and gases. Various English kings, legislation, and committees attempted to regulate its use. In 1952, the death of 4000 persons in London led to strict controls. Smog also caused deaths in England. In America, the incident at Donora, Pennsylvania spurred pollution control efforts. In Poza Rica, near Mexico City, hydrogen sulfide caused deaths and illness. Other pollutants, such as metallic fumes, acid mists, fluorides, and odors, have also caused health problems. While oil and gas have replaced coal, they have caused further pollution. Evidently, photochemical reac-

tions in automobile engine exhausts have caused Los Angeles smog. Air pollution is directly related to energy sources; a major change in energy sources could change the quality of air pollution. Carbon dioxide in the atmosphere has increased with the use of fossil fuels. Pollutants can be emitted directly from identifiable sources or can be produced in the air by an interaction between two or more primary pollutants, or by a reaction with normal atmospheric constituents. The first group includes aerosols, coarse particles, and sulfur, organic, nitrogen, carbon, halogen, and radioactive compounds. Secondary pollutants include halide salts, sulfuric acid mist, photochemical reactions, and the absorption of gases by surfaces of liquid and solid particles. Nucleation, condensation, sedimentation, and meteorological processes also effect the formation and impact of primary and secondary pollutants. Air pollution can cause a reduction in visibility, material damage, agricultural damage, physiological effects on man and domestic animals, and psychological effects. Air pollution will be a larger problem in the future. Its emergence as a global phenomenon will effect many governmental and administrative procedures.

32139

Gartrell, F. E.

WATER POLLUTION POTENTIAL OF AIR POLLUTION CONTROL DEVICES. In: Air Pollution. Arthur C. Stern (ed.), Vol 3, 2nd ed., New York, Academic Press, 1968, Chapt. 49, p. 535-549. 22 refs.

Devices for air pollution control which reduce the amount of waste material discharged to the atmosphere usually increase the quantities of such materials that must be disposed of by other means. Wet collectors of many types are used for air cleaning and all types contribute to the total quantity of liquid wastes which may be discharged to waterways, with or without treatment. With industrial development, urban population growth, and rapidly expanding use of water for all purposes, the accompanying need for stream pollution control has led to the establishment of agencies with the authority to regulate the discharge of waste materials to surface waters. From a review of water quality standards, it is obvious that many waste materials considered as air pollutants of major concern are likewise objectionable for many water uses, when present in even fairly low concentrations. This is particularly true of wastes involving fluorides, sulfur compounds, and radioactive materials. The control of fluorine wastes from uranium ore processing, phosphate fertilizer production, and steel mills, is discussed. Radioactive waste disposal practices at the Oak Ridge National, the Argonne National Laboratory, and at the Los Alamos Scientific Laboratory are described. The control of sulfurous wastes is indicated for copper smelters and electric power plants. The control of fly ash, dust, and other particulate wastes from calcium carbide plants, blast furnace operations, power plants, and chemical plants is reviewed.

32519

Hartkopf, Guenter

ENVIRONMENTAL PROTECTION AND POWER PRODUCTION. (Umweltschutz und Elektriziteatswirtschaft). Text in German. Elektriziteatswirtschaft, 70(17):507-511, 1971. (Presented at the VDEW Jahrestagung, Mainz, West Germany, May 27, 1971.)

The conversion to electricity as a source of energy in households, trade, industry, and transportation (railroads) transferred the burden of the air pollution problem from several sources to one large-scale source. Power plants emit dust, sulfur dioxide, nitrogen oxides, carbon monoxide, hydrocarbons, fluorine, and chlorine. Processes for SO2 removal from waste gases, desulfurization of fuels, and siting of power plants are investigated as air pollution control methods.

32576

Vitaliano, Dorothy B.

FLUORINE-BEARING ASH FROM THE HEKLA ERUPTION, 1970: DISTRIBUTION, EFFECT ON ENVIORNMENT, AND IMPLICATIONS FOR MEDITERRANEAN ARCHEOLOGY AND GEOMYTHOLOGY. In: Boston College Environmental Center Summer Institute on Surtsey and Iceland. National Aeronautics and Space Administration, Moffett Field, Calif., Ames Research Center, NASA TM X-62,009, p. 65-68, Feb. 1971. 3 refs. NTIS: N71-17982

In addition to its effect on the environment in Iceland, the occurrence of fluorine-bearing ash in the 1970 eruption of Hekla, as in the 1947 eruption of that volcano, has interesting implications in connection with Mediterranean archeology and geomythology. It seems likely that the 1970 eruption of Hekla may furnish a clue as to how the Santorin eruption of 1450 B.C. could have been responsible for the adverse effects caused to the plants, cattle, horses, asses, camels, oxen, and sheep of the Egyptians who were downwind of the eruption.

32702

CONTAMINANTS IN THE AIR. WHAT THEY ARE: Ind. Power, 62(1):68-70, Jan. 1952.

Smoke, dusts, fumes, mists, vapors, and gases are defined in terms set forth by the American Standards Association. Common sources of contaminants are discussed and shown on a chart, and common airborne particles are listed according to size in micron. Pollutants include pollens, bacteria, viruses, metal dusts and fumes, magnesium oxide fumes, cement dust, foundry dust, pulverized coal fly ash, zinc oxide fume, sulfur trioxide, carbon black, sulfuric acid mist, particles of coal and ash from furnaces, organic matter, and industrial wastes. In addition, the particle sizes of various contaminants are compared according to both micron diameter and Tyyler scales. The effects of, or atmospheric reactions involving, sulfur dioxide, hydrogen sulfide, nitrogen oxides, and fluorine compounds are briefly reviewed. The physical properties of particles are contrasted with the chemical nature of their constituents and are noted to be even more important in atmospheric pollution. Inversions and wind can effect the distribution of pollutants.

32855

Ishiguro, Tatsukichi, Kazuo Hishida, and Tsunehiro Yajima

PRESENT STATE OF PUBLIC NUISANCE CAUSED BY OFFENSIVE ODORS IN TOKYO. (Tokyo ni okeru akushu kogai no genjo). Text in Japanese. Yosui To Haisui (J. Water Waste), 13(8):972-978, Aug. 1971.

Control criteria were designated for emissions of smoke, gases, and offensive odors in Tokyo. The harmful gases included ammonia, fluorine and its compounds, hydrogen cyanide, carbon monoxide, formaldehyde, methanol, isoamyl alchohol, isopropyl alcohol, hydrogen sulfide, hydrogen chloride, acrolein, acetone, sulfur dioxide, benzene, nitrogen oxides, toluene, phenol, sulfuric acid, and chromic acid. The public Nuisance Bureau received 2751 complaints about offensive odors and 416 complaints about deleterious gases during 1970. The major sources of the offensive odors were plants processing fish guts and bones, animal bones and fat, and

feathers, stock yards, poultry farms, urban waste disposal plants, sewage treatment plants, fish oil processing plants, varnish manufacturing plants, lubricant oil regenerating factories, soy sauce lees and other vegetable protein processing plants, organic fertilizer manufacturing plants, and food manufacturing plants. Deodorization experiments were conducted with respect to the analysis of the components of odors, deodorizing devices, sensory tests, interrelation of odor constituents, and process improvements.

33735

Hellwig, A. and D. Hempel

STUDIES OF THE RELATIONSHIP BETWEEN THE EMISSION OF FLUORINE COMPOUNDS AND THEIR CONCENTRATION IN ATMOSPHERIC AIR AND WATER. (Untersuchungen ueber den Zusammenhang zwischen der Emission von Fluorverbindungen und ihrem Gehalt in der atmosphaerischen Luft und im Wasser). Text in German. Z. Ges. Hyg. Ihre Grenzgebiete (Berlin), 17(9):651-655, Sept. 1971. 20 refs.

Fluoride compounds are frequently components of industrial emissions. Hydrogen fluoride is emitted in the manufacturing of bricks and clay. The most important source for fluorine-containing emissions is the chemical industry. Fluorine is a natural component of human and animal tissue. Man needs a daily dose of 1.5 to 1.8 mg fluorine which is supplied by the water (0.1 mg) and by food (0.4 mg). In the vicinity of a superphosphate plant, the fluorine content of the atmosphere was determined at eight measuring stations. More measuring stations were set-up in the main direction, i.e., east and northeast of the emission source. All stations were arranged in distances of 200 to 3000 m from the emission source. The measurements were taken every two weeks with the aid of an automobile. At each station, 40 individual measurements were taken between July 1968 and June 1970. The air was drawn through two subsequent absorption vessels at a speed of 5 l/min each of which was filled with 15 ml 0.05 N NaOH. The fluorine concentration was determined by measurement of the extinction at a wave length of 530 nm. The highest concentrations were measured at a distance of 300 and 1000 m from the stack in a south-eastern direction. The maximum allowable emission concentration for fluorine (0.03 mg/cu m short-term value, 0.1 mg/cu m long-term value) has not been exceeded at any one time or at any point.

33853

Ryder, R. J. and J. J. McMackin

SOME FACTORS AFFECTING STACK EMISSIONS FROM A GLASS CONTAINER FURNACE. PART I. Glass Ind., 50(6):307-310, June 1969. (Presented at the Conference on Glass Problems, 29th, Nov. 21, 22, 1968.) PART II. Ibid., 50(7):346, 348-350, July 1969. 4 refs.

A glass melting furnace can give off emissions from the flame and from volatilization. Sulfates, fluorides, and borates are major constituents that contribute to volatilization. A small percentage of these materials becomes stack gas and can cause air pollution. A glass furnace was tested to determine the amounts of particulate matter, sulfur dioxide, sulfur trioxide, carbon monoxide, hydrocarbons, and nitrogen oxides in the stack gas. Also, the plume s opacity was determined. Variation in the furnace load, temperature, fuel-air ratio, and make-up of minor ingredients could effect stack emission. The particulate emission (primarily sodium sulfite), SO2, SO3, and nitrogen oxides increased as the furnace load (and thus temperature) increased. An increase in excess air from 20-25% to 30-35% produced decreases in the level of particulate emission. The addition of carbon to the minor-ingredient mix eliminated this. Also, the addition of carbon was the most effective single factor in decreasing particulate emission. The apparent opacity was influenced by the fuel-air ratio but was not affected by the minor-ingredient mix. Furthermore, increases in excess air in the 20-40% range caused significant opacity decreases. As expected, the opacity increased as the furnace load increased. Because of Los Angeles regulations, the maximum load is dictated by the level of particulate emission and stack plume opacity.

34018

Bernhart, A. P.

NOTES ON AIR POLLUTION: THE INGREDIENTS DEFINED. PART I. Water Pollution Control (Toronto), 109(10):41-42, Oct. 1971. 19 refs.

The problem of air pollution in Canada is reviewed with respect to effects on human health (respiratory diseases), animals, plants, buildings (soiling and deterioration), traffic (visibility), and economy; breakdown by individual pollutant; and major sources. The major pollutants and their sources included suspended particulates and dust fall from furnaces, incineration, and cement plants; pollen from grasses and trees; sulfur oxides from coal furnaces; carbon monoxide from cars; hydrocarbons from engine exhausts and gasoline evaporation; aldehydes from diesel exhausts and dry cleaners; nitrogen oxides from power plants; oxidants; odors from slaughterhouses, garment factories, glue factories, and diesel buses; fluorides from aluminum and fertilizer plants; lead from car exhausts; benzopyrene; carbon dioxide; and other minor pollutants, i.e., organic acids, hydrogen sulfide, ammonia, chlorine, and bromine.

34096

Schmidt, E.

FORMATION AND EMISSION OF AIR-POLLUTING SUBSTANCES IN BRICKWORKS KILNS. (Auswurf und Entstehung luftverunreinigender Stoffe bei Ziegelofen). Text in German. Ziegelind. (Wiesbaden), no. 24:560-571, 1968. 14 refs.

Emission measurements for 60 brick ovens revealed that soot emission levels from old ovens with simple combustion installations often exceed maximum permissible levels while modern kilns easily conform to prescribed standards. The median sulfur dioxide emission was 0.5 g/N cu m, but emission levels varied rather widely. Sulfur oxides from brick kilns contained a considerably higher share of SO3 than emissions from other types of furnaces. Fluorine concentrations ranged from 1 to 184 mg/N cu m (median level, 48 mg/N cu m). The emission of sulfur oxides and fluorine is governed by the composition of the materials used in brick manufacture, especially the lime content, and by the firing temperature. Emissions increase with higher firing temperature and decrease with lime content. A higher emission of sulfur oxides is usually accompanied by higher fluorine emissions. To comply with prescribed emission standards for sulfur oxides, stack heights of 20 to 40 m are necessary; for fluorine, from 20 to 50 m. In special cases high stacks will not suffice and the blowing of powdered magnesite or of dolomite into the furnace may be necessary.

34334

Porteous, A.

SOME ASPECTS OF AIRBORNE POLLUTANTS AND THEIR EFFECTS ON LIVE SUPPORT SYSTEMS. Public Cleansing (London), 61(10):485-492, Oct. 1971. 4 refs.

Increases in population and affluence have combined to produce wastes and environmental tampering on an un-

precedented scale. The decompositon of these wastes through incineration produces air pollutants that are potentially damaging to life support systems. Domestic refuse, for example, has a composition of roughly 30% ash clinkers and coal dust, which is a potential source of sulfur dioxide when incinerated. Sulfur dioxide and fluorides can affect life and even small concentrations cause selective damage to vegetation. The decomposition of plastics under high-temperature condition gives rise to the possibility of acid mists and the emission of polychlorinated biphenyls. Low concentrations of PCBs can be concentrated biologically until they affect living systems. Atmospheric dust from combustion and other industrial processes is linked to the decrease in atmospheric temperature which has shortened the average growing season since 1950 by about two weeks. There are three SO2-removal processes which may be feasible on a large scale: Reinluft, Cat-ox, and alkalized alumina.

35592

National Materials Advisory Board, Washington, D. C., Panel on Fluorspar

TRENDS IN THE USAGE OF FLUORSPAR. National Academy of Sciences - National Academy of Engineering, Washington, D. C., Pub. NMAB-269, 54p., Dec. 1970. 21 refs. NTIS: PB 198339

Three major segments of American industry (steel, aluminum, and fluorocarbon producers) use approximately 93% of the fluorspar consumed in the United States and will probably continue to require large and assured supplies well beyond the next decade. The fluorspar demand of the aluminum industry may decrease because of fluorine recovered from waste products and phosphate production. However, the overall fluorspar demand should contiue to grow as the result of increasing requirements for the product of steel and fluorcarbons. The total fluorspar demand was 1.24 million tons in 1968 and is projected to increase to 1.8 million in 1975 and to 2.2 million in 1980. Due to environmental concern, secondary sources of fluroine are beginning to be exploited in greater volume. The principal source is a by-rooduct from the production of phosphates. (Author abstract modified)

35985

Cooke, N. E., R. M. Cooper, and R. H. Andres

POLLUTION CONTROL AT A LARGER FERTILIZER COMPLEX. Safety Air Ammonia Plants, vol. 13:23-28, 1971.

Although the pollution abatement facilities at a fertilizer complex of Canadian Industries Ltd. were expected to enable air quality regulations to be met, CIL decided that it would be desirable to monitor its operations to ensure that this was being accomplished, to indicate the malfunction of pollution control equipment, and to enable repair of such equipment before environmental damage could occur. A survey sampling grid was set up to measure fluorides, sulfur dioxide, and particulate matter. The major source of fluoride emission to the atmosphere is the diammonium phosphate plant, where phosporic acid is reacted with ammonia. Ground level concentration data are indicated, and a model to simulate any combination of circumstances by mathematical means is presented. A venturi scrubber was installed between the ammonia scrubber and the dust scrubber stack, using gypsum pound water as the scrubbing medium, thus lowering the fluoride emissions. Water quality monitoring, particulate emissions, ammonia plant condensate, and solid waste disposal are also discussed.

36045

Dams R., R. Heindryckx, and K. van Cauwenberghe

CHEMISTRY AND DETERMINATION OF AIR POLLUTANTS. (Scheikunde en analyse van luchtpollutie). Text in Dutch. Ind. Chim. Belge, 36(7):589-626, 1971. 231 refs.

Gaseous pollutants include sulfur compounds, hydrocarbons, nitrogen compounds, ozone, fluoride compounds and chlorine compounds. Sampling methods are explained. The term Residence Time is defined. Sources of sulfur containing gases are tabulated, and chemical reactions of sulfur dioxide formation are given. Methods of analysis of sulfur dioxide are described. Biological and toxicological effects of hydrogen sulfide are described. The sources, measurement, formation, and possible effects of carbon dioxide, fluorine and chlorine compounds, carbon monoxide, and nitrogen oxides are discussed. The natural cycle of ozone in atmosphere and polluting effects of ozone are described. The phenomenon of photochemical mist formation in London and Los Angeles is described. Also mentioned are: Reduction of visibility through smoke, aerosols and photochemical generation of mists; effects on materials; effects on agricultural products through sulfur dioxide, fluorides, or ozone; and physiological and psychological effects.

36212

Schmidt, E.

THE FORMATION AND EMISSION OF AIR POLLUTING SUBSTANCES BY BRICK KILNS. (Auswurf und Entstehung luftverunreinigender Stoffe bei Ziegelofen). Text in German. Ber. Deut. Keram. Ges., 45(11):579, Nov. 1968.

Measurements of emissions from 60 brick factories revealed closed that the emission of particulates from old kilns of simple construction often exceeded maximum permissible levels while modern easily conformed to prescribed limits. Sulfur dioxide emissions fluctuated widely within 0.1 and 1.8 g/N cu m. SO3 comprised 5-50% of the total sulfur oxides emitted; thus, the emission of SO3 from brick ovens is higher than from other types of furnaces. All brick clays contained small amounts of fluorine compounds with 0.02 to 0.1% F. Fluorine emission levels fluctuated from 1 to 125 mg/N cu m. Dispersion of SO2 requires stacks 20 to 40 m high stacks; for F, 20 to 50 m stacks are necessary. Emissions increased with increasing combustion temperature and decreased with increasing lime content in the brick clay. High SO2 emission is usually coupled with high emission of F.

36377

Taga, Tahakide

CONTINENTAL REPORT: ASIA. International Union of Air Pollution Prevention Associations, Intern. Clean Air Congr., Proc. London, England, 1966, p. 22-24. (Oct. 4-7 Paper II/4.)

The problem of air pollution in Formosa, the Korean Republic, the Philippines, Thailand, India, and Japan is reviewed with respect to pollutants, emission sources, control agencies, air quality measurements, and legislation. Cities with the greatest pollution problem are listed. Standards were established for dust fall from fuel combustion and incinerators, oxidants, carbon oxides, nitrogen oxides, and sulfides from commerical and industrial activities (Formosa); smoke, fumes, and dusts (including cyanides, fluorides, phosphorus compounds (Korea); soot, dust particles, sulfur dioxide, hydrogen fluoride, hydrogen sulfide, hydrogen chloride, nitrogen dioxide, chlorine, carbon dioxide, hydrogen cyanide, and ammonia (Japan). The major sources of pollution in Asia include automobiles, power plants, unpaved roads, lumber mills, chemical processing, cement factories, domestic ovens, and pulping.

37190

ENVIRONMENTAL PROTECTION AND CULTIVATION OF THE ENVIRONMENT IN LOWER SAXONY. (Umweltschutz und Umweltpflege in Niedersachsen). Text in German. Staedtehygiene (Uelzen/Hamburg), 22(11):266-267, Nov. 1971.

The emission limit values for sulfur dioxide and dust are exceeded in Lower Saxony during normal weather conditions only in individual critical areas. In the Nordenham area the soil and the vegetation are heavily enriched with lead and zinc dust, sulfur dioxide, and fluorine. The lead content of the soil has reached 120 times and zinc has reached 150 times the normal values. The milk of animals grazing in this area has to be heavily mixed with other milk in order to make it drinkable. In Delmhorst, the natural composition of the air is changed by the emissions of a linoleum plant and a lacquer-resin plant. During the oxidation of linseed oil and the melting of resins, acrolein, formic acid, acetic acid, and phenols are liberated. In Osterwald, the fluorine emissions of a ceramic plant has destroyed a large forest. Injuries in forests were also observed in Bad Salzdetfurth from the emissions of a potassium plant and near Munich by a cellulose plant. Animal mass breeding stations cause unbearable odor emissions in Suedoldenburg, Bersenbrueck, Diepholz, Bassum, and Nienburg.

37562

Reimer, Hans

REMOVAL OF PLASTIC WASTE BY MEANS OF INCINERATION. (Beseitigen von Kunststoffhaltigem Muell durch Verbrennen). Text in German. Muell Abfall, 4(1):19-21, Jan. 1972. 7 refs. (Presented at the Muelltechnischen Kolloquium des Forschungsund Entwicklungs-Instituts fuer Industrie- und Siedlungswasser wirtschaft der Technischen Universitaet, Stuttgart, West Germany, Oct. 15, 1971.)

The incineration of plastic waste causes problems deriving from the fact that plastic material develops gases. Since the combustion temperature in the incineration plant has to exceed 850 C in order to avoid bad odors and the temperature level must not exceed 350 C for dedusting the flue gas, the flue cases have to be cooled down by water or air. In this case, however, the flue gases get into direct contact with metallic material causing corrosion because of the content of chloride in the plastic waste, forming ferrochloride in a reducing atmosphere, and peeling the material. Methods against corrosion are adding of secondary air which prevents the formation of inhomogeneous flue gas concentrations and avoiding the use of metallic material up to a grate height of 2m. Tests are given to bind the developing chloride by physical or chemical means like dolomite. Concerning the emissions of hydrochloric acid, the concentration in the flue gases rarely exceeds 1000 mg/N cu m, and is expected to raise to 2000 mg/cu m in 1980. The emission concentration of hydrofluoric acid amounts to 8 - 10 mg/cu m.

37721

Ministry of Health and Welfare (Japan) Dept. of Environmental Pollution Control

ABOUT THE NATURE AND EFFECT OF HARMFUL SUBSTANCES (POISONOUS [illegible]) DELETERIOUS SUBSTANCES CONTROL LAW. Article [illegible]em 1, No. 3. (Yugai busshitsu (Ho dai 2 no, Dai 1 ko, Dai 3 [illegible] no seijo oyobi eikyo ni tsuite). Text in Japanese. 44p., May 1971.

The nature, permissible concentration, and measurement methods of cadmium, chlorine, fluorine, lead, nitrogen, and their compounds. Cadmium and its compounds include metallic cadmium, cadmium oxides, and cadmium salts. Oral and inhaled toxicities are mentioned. The dithizone method is used to measure cadmium. The rhodanic mercury method is used to measure hydrogen chloride and the detecting tube method and the orthotolizine method is used to measure chlorine. Acute and chronic effects of chlorine compounds are discussed. Fluorine, hydrogen fluoride, difluoric oxides, and fluorides are measured by the alizarin complexon method. Lead, inorganic lead compounds, metallic lead, lead oxide, lead chloride, and organic lead each have unique toxic properties. The dithizone method is used to measure lead. Nitric oxide, nitric anhydride, nitrous oxide and nitrogen dioxide are discussed. The detecting tube and naphthylethylene-diamine methods are explained.

37752

Locher, F. W., S. Sprung, and D. Opitz

REACTIONS ASSOCIATED WITH THE KILN GASES. CYCLIC PROCESSES OF VOLATILE SUBSTANCES, COATINGS, REMOVAL OF RINGS. (Zement-Kalk-Gips (Wiesbaden), 25(1):1-12, Jan. 1972. 46 refs. (Presented at the Verein Deutscher Zementwerke Congress, Duesseldorf, West Germany, Sept. 28-Oct. 1, 1971.)

In addition to dust from the process material the gas stream in a cement kiln contains mainly alkali sulfates, alkali chlorides, and calcium fluoride formed by reaction in the kiln gas after vaporization from the material. If these compounds react with or are precipitated on the material in the colder parts of the kiln, they will form an internal cycle. If they are precipitated in the gas cleaning installation and are then returned to the process, they will form a closed external cycle which will be broken if the substances in question are discarded with the dust collected in the precipitator. Material balance investigations on 11 kilns with suspension preheaters and 10 kilns with grate-type preheaters determined that the internal alkali and sulfur cycles are approximately equal. Approximately equal amounts of alkali and sulfate are also precipitated with the dust; dust quantities for the suspension preheater are 50-117 g/kg of clinker as compared with up to 20 g/kg for the grate-type preheater. The reaction with the alkalies is of decisive important with regard to sulfur dioxide emissions. The internal chloride cycle increases steadily if the chloride content of the raw meal exceeds 0.01-0.015% by weight. The fluoride is combined mainly in the clinker. Objectional coatings and meal, sinter, and clinker rings can be obviated by appropriate reduction of the cycles in question (coatings and meal rings) or by reduction of the proportion of fusible matter in the clinker (sinter and clinker rings). A further condition to minimize the formation of objectionable coatings is proper routine operation of the kiln. Effective methods for the removal of coatings and rings include cutting with high- or low-pressure water jets, dislodging with a gun, or destroying by explosive action with the Cardox process.

37996

Escourrou, R.

THE SCOURGE OF POLLUTION. (Le fleau de la pollution). Text in French. Papeterie, 93(11):1025-1026, 1029-1032, 1035-1038, 1041-1045, Nov. 1971.

Air, water, and noise pollution are discussed. Dust generation is discussed, with particular emphasis on cement works. Gaseous pollutants include sulfur dioxide, fluorine derivatives, carbon monoxide, and odors (from spray painting shops, animal food production, and motor vehicle exhausts). The sampling of air is briefly described, as well as methods of determining concentrations of sulfur dioxide, fluorine, and dust. Water pollution, effects on fish, and sources of water pollution are discussed. Pollution of the sea by atomic fallout, residual oil,

effluents from coastal industries, and the discharge from sewers is discussed. A suggested permissible noise limit for city conditions would be 80 to 85 decibels. A motor vehicle traveling at 50 mi/hr exceeds this noise level.

38657

Fuhrmann, N.

PROBLEMS OF ENVIRONMENTAL PROTECTION IN BASIC-INDUSTRY PROCESSING PLANTS. (Probleme des Umweltschutzes bei verfahrenstechnischen Anlagen der Grundstoffindustrie unter besonderer Berucksichtigung gesetzlicher Vorschriften zur Luftreinhaltung und Laermbekaempfung). Text in German. Aufbereitungs-Technik, 12(12):757-763, Dec. 1971. 25 refs.

Branches of industries such as cement plants, soft and hard coal briquetting plants, cokeries, and iron ore sintering plants are large air polluters. Great efforts have been undertaken to reduce emission. In the cement industry, for instance, the average dust emission dropped from about 3.5% in the year 1950 to 0.15% of the clinker production in 1967. Over the same period the clinker production rose from 11 million tons to 33 million tons. The technical directives limit the dust emissions by cement grinding stations to 150 mg/cu m. The gaseous emissions from cement plants are negligible. The soft coal briquetting plants of the German Democratic Republic emitted about 260,000 tons of dust in 1967. In hard coal briquetting plants the emission of benzo-3,4-pyrene must be mentioned in addition to the dust emission. Cokeries emit dusts, tar aerosols, and gases, particularly hydrogen sulfide and sulfur dioxide. In 1956 the SO2 emission by these plants amounted to 56,000 tons. Through scavenging of the gases, the SO2 emissions can be greatly reduced. In iron ore sintering plants, dust and SO2 are emitted. The SO2 concentration in the uncleaned gas may reach 10 g/cu m. At an annual production of 20 million tons of sinter, about 210,000 tons of SO2 are emitted. These plants also emit fluorine. The federal government drafted a law expanding its constitutional rights to include the fields of water pollution, maintenance of clean air, and noise abatement. Emission limits for basic industry processing plants are included in the technical directives pertaining to air.

39460

PARTICULATE POLLUTANT SYSTEM STUDY. VOLUME I - MASS EMISSIONS. Midwest Research Inst., Kansas City, Mo., Air Pollution Control Office Contract CPA 22-69-104, MRI Proj. 3326-C, 372p., May 1, 1971. 198 refs.

A program to assess particulate air pollution from stationary sources in the continental United States and to advance the capability of control equipment for particulates was conducted. All significant sources of particulate pollutants are identified, and the most important sources are evaluated. Future problem particulate emission sources, determined by projecting production trends, control efficiency, and control equipment application trends, were identified. Research and development plans were formulated to fill in the knowledge gaps pinpointed during the study. From the list of significant sources, a ranking of the most important sources by total tonnage emitted was developed by calculating total emissions using emission factor techniques and other calculation methods. Important sources by tonnage are fuel combustion in stationary sources; crushed stone, sand, and gravel; operations related to agriculture; iron and steel manufacturing; cement plants; forest products; lime; clay products; primary nonferrous metals; fertilizer manufacturing; asphalt; ferroalloys; iron foundries; secondary nonferrous metals; coal preparation plants; carbon black; petroleum refining; and acid manufacturing. Sources and air pollutants were ranked by objectionable properties. In order they were: carcinogens, beryllium and mercury, toxic metals, mercaptans, isocyanates, asbestos and silicates, very toxic metals, fluorides, alkyl amines, hydrogen sulfide, calcium oxide, mineral acids (hydrochloric, nitric, sulfuric, and phosphoric acids), sulfates, nitrates, sulfur oxides, organic sulfides, pyridines, nitrogen oxides, chlorine, soot, smoke, carbon black, less toxic metals, fly ash, inert particulates, oxidants such as ozone, olefins, aldehydes, phenols, aniline, aromatics, chlorocarbons, mixed organics, ammonia, hydrocarbons, and carbon monoxide.

39587

Marier, J. R.

THE ECOLOGICAL ASPECT OF FLUORIDE. Fluoride, 5(2):92-97, April 28, 1972. 21 refs. (Presented at the International Society for Fluoride Research, Annual Conference, 4th, the Hague, Netherlands, Oct. 24-27, 1971.)

Research results have shown that fluorides tend to be the major atmospheric pollutant involved in a situation that also involves sulfur dioxide. The possible synergism involving more than one pollutant must be thoroughly investigated since a simple additive effect would underestimate the condition if a synergism magnifies the combined effect of the two pollutants. Another example of synergism involves the magnitude of fluoride uptake in vegetation, arising from the use of fluoride-containing phosphate fertilizers. The presence of only 0.11 mg/l of available boron doubles the uptake of fluoride via the root-system of vegetation. A study determined that exposure of aquatic vegetation to 100 ppm of water-borne fluoride for 5 days increased the vegetation fluoride content 50-fold, whereas exposure to 20 ppm for 14 days increased it 38-fold. No information is available concerning exposure to lower level of water-borne fluoride for longer periods of time. The possibility that vegetation exposed to fluoric air-pollution are able to convert inorganic fluoride to the much more toxic fluoroacetate and fluorocitrate forms is considered. Recycling of the emitted fluorides for use in syntheses of useful compounds would benefit the industries and the ecosystem.

39635

Routschka, G., Ch. Buttgereit, and U. Berger

FLUORINE CONTENT OF REFRACTORY CLAYS AND FLUORINE EMISSION DURING FIRING OF FIRE-CLAY PRODUCTS. (Der Gehalt an Fluor in feuerfesten Tonen und Schamotte und die Beeinflussung der Fluorabgabe beim Brand der Schamotteerzeugnisse). Text in German. Sprechsaal Keram. Glas Email Silikate, 103(20):901-906, Oct. 2, 1970. 10 refs.

The influence of different factors on the final fluorine content in refractory clays was studied. During firing, 40% of the total (0.03-0.06%) fluorine content is volatilized. Fluorine removal starts at 400-500 C and is intensified with increased temperature until sintering processes start. High sulfur dioxide concentrations and mainly water vapor in the atmosphere have enhancing effects. The volatilization during firing is influenced by the sintering of the raw material and the porosity. Fluorine removal is additionally influenced by both shape and wall thickness of the products. The removal from the near-surface layer, at a temperature of 900-1000 C, is more intense than from the core, where it occurs at 1200 C. The fluorine removal is considerably less intense in production than in experimental firing.

39862

Shipley, J. W.

SOME CHEMICAL OBSERVATIONS ON THE VOLCANIC EMANATIONS AND INCRUSTATIONS IN THE VALLEY OF 10,000 SMOKES, KATMAI, ALASKA. Amer. J. Sci., 50(296):141-153, 1920. 12 refs.

Volcanic gases have been pouring out continuously from vents distributed over a 50-square-mile area since the eruption of the Katmai crater in southwestern Alaska in 1912; in the course of time they have built up large masses of incrustants around the vents. Examination of the incrustants revealed the presence of the following compounds: sulfur, arsenic, fluorides, corundum, silica, boron, gypsum and apatite, potassium alum, iron, vivianite, pyrite, manganese, and aromatic hydrocarbons. Water vapor was the major component of the issuing gases, but hydrogen sulfide, sulfur dioxide, volatile ammonium compounds, and hydrochloric and hydrofluoric acids were also detected. While the majority of incrustants were secondary products arising from decomposition of ash by volcanic gases, the great volume of escaping vapors had a magmatic origin. The mineralization going on in the area may be due to water liberated by contact of the crystallized crust of earth with heated magma.

40159

Brandt, A. D. and D. M. Anderson

MEASURES AGAINST AIR POLLUTION CAUSED BY INDUSTRIAL SOURCES. (De strijd tegen de luchtvervuiling afkomstig van industriele bronnen). Text in Dutch. Polytech. Tijdschr., Ed. Procestechniek (The Hague), 27(7):231-237, 1972. 26 refs. (Presented at the Environmental Control Seminar, Rotterdam, Netherlands, May 25-26, 1971).

A general survey is given of air pollution from industrial sources in the United States, with special regard to particulate, gaseous, and fluorine pollution. The contribution of industry to air pollution was 14% with 30 million tons in 1968. Particulate pollutants are most important, followed by sulfur dioxide, hydrocarbons, carbon monoxide, and gaseous and particulate fluorine compounds. To effectively control air pollution, improved source localization techniques are required. General principles and uses of pollution control equipment such as cyclones, tissue filters, scurbbers, and electrostatic filters are reviewed. Contributions of several industries to particulate and gaseous pollution in 1967 are reviewed. Quarrying, gravel, and sand processing was the major source of particulate emissions with 4.6 million tons, followed by grain mills with 2.952 million tons. Compared to other industries, a high proportion of the emission sources is localized in the iron and steel industry, (1.490 million tons). Cokeries are a major source of HC emissions. The respective contributions by the paper and asphalt industries were 633,000 and 522,000 tons. The joint share of the cement and lime industries is 744,000 tons, followed by foundries with 217,000 tons. Brick manufacturing was responsible for the bulk of fluorine emissions. The chief sources of sulfur dioxide, carbon monoxide, and hydrocarbon emissions were primary nonferrous smelting (2,940,000 tons from the copper industry alone), petroleum refining (6.2 million tons), and petroleum products processing (1.1 million tons), respectively.

40180

Kearney (A. T.) and Co., Inc., Chicago, Ill.

AIR POLLUTION ASPECTS OF THE IRON FOUNDRY INDUSTRY. Office of Air Programs Contract CPA 22-69-106, Rept. APTD-0806, 260p., Feb. 1971. 18 refs.

A study directed at the iron foundry industry, with particular emphasis on the melting area, was undertaken in order to examine those aspects pertinent to air pollution. Pollutants commonly discharged by such industries include smoke, metallic oxides, oil vapors, carbon monoxide, sand fines, metal dust, and coke dust, odors, fluoride fumes, vapors, and facing fumes. Particulate emissions have been a point of focus for concentrated efforts in air pollution; however, gaseous emissions and odors from the foundries have not been given much attention, and the foundry industry now has to take steps to suppress these discharges into the atmosphere. The physical difficulties of satisfactory collection of pollutants are not easily solved and, in most cases, costs of satisfactory collection are quite high. A lack of correlation between standard furnace design factors and emission levels indicates a variance in operating factors. One group of variables is related directly to cupola operation, including specific blast rate, blast temperature, type of lining, and operating variables of the afterburner. A second group of variables concerns the quantity and quality of charge materials. Reproducibility of test results is difficult with any given technique, even for a stable emissions producing system. Compounded further by the use of different techniques, equipment, and testing companies to obtain data for comparison and analysis, the confidence level of the data must suffer, despite the high degree of professionalism of the laboratories performing the tests. Control methods include centrifuges, scrubbers, filters, afterburners, preheaters, hoods, and electrostatic precipitators.

40182

Takahashi, Noboru

ENVIRONMENTAL POLLUTION BY METAL INDUSTRIES. (Kinzoku sangyo ni yoru kankyo osen). Text in Japanese. Kagaku (Science), 41(10):551-556, Oct. 1971.

Iron works produce mineral powder and coke powder as particulates and sulfur dioxide. More than 50% of the SO2 is from the sintering process. By an approximate calculation, a plant with a capacity of annual production of 1000 tons crude steel produces 7,000,000 cu m SO2 every year. The SO2 gas from an iron works also contains extremely poisonous arsenic trioxide. The same plant discharges about 2400 tons of waste water yearly. Casting industries generate approximately 6000 tons of particulates yearly, of which about 50% are silicon dioxide. In zinc production industries, cadmium is generated since its contamination in zinc mineral is approximately 0.25%. It is discharged as dust into air and as waste in waste water. In aluminum refining, fluorides are generated, and for a production of 1 ton aluminum about 20 to 30 kg of fluorine are also produced as fluorides. Cyanides are largely used in metal gilding and thermal treatment, approximately 50% for the former and 30% for the latter. These cyanides, accompanied with cadmium, have been the major pollutants in the rivers in large cities.

40344

Engineering Science, Inc., Washington, D. C.

EXHAUST GASES FROM COMBUSTION AND INDUSTRIAL PROCESSES. Engineering Science, Inc., Washington, D. C. Office of Air Programs Contract EHSD 71-36, 431p., Oct. 2, 1971. 163 refs. NTIS: PB 204861

Combustion and industrial processes were investigated to determine the extent to which operating variables and process throughput rates affect exhaust gas conditions and emission rates and to recommend exhaust gas conversion factors to be used in the development of implementation plans for air quality control development of implementation plans for air quality

control regions. For each source category, gas flow rate, temperature, and velocity and stack height were evaluated and the operation of the industry, process description, and input-output relation were reviewed. Collection efficiencies were calculated for baghouses, electrostatic precipitators, high- and low-energy scrubbers, mechanical collectors, afterburners, adsorption methods, and scrubbers. Complete data are presented for exhaust gases from combustion of coal, fuel oils, natural gas, and wood wastes within power plants, and industrial processes; domestic heating; incineration; open burning; solid waste disposal; chemical processes; paint and varnish manufacturing; soap and detergent manufacturing; synthetic rubber and fiber plants; food and feed operations; primary and secondary metallurgical processes; sintering; mineral processing; petroleum refining; pulp mills; dry cleaning; surface coating operations; and gasoline marketing. Pollutants emitted by the various processes include solvents, alumina, copper oxides, metal fumes, chlorides, lead oxides silica, fly ash, particulates, sulfur oxides, nitrogen oxides, sulfur dioxide, soot, chlorine gas, carbon dioxide, carbon monoxide, hydrogen fluoride, hydrogen sulfide, ammonia, organic vapors, fluorides, phosphoric acid mist, aldehydes, hydrogen chloride, hydrocarbons, zinc oxides, dusts, and odors.

40401

Brocke, Werner

FORECASTING OF POWER PLANT-, INDUSTRY- AND DOMESTIC HEATING-CAUSED AIR POLLUTION. (Prognose der Luftbelastung durch Emissionen stationaerer Feuereungsanlagen in Kraftwerken, Industrie und Haushalt). Text in German. Luftverunreinigung, 1971:20-25, Dec. 1971. 12 refs.

Forecasts are given for the air pollution caused by fossil fuel-based stationary firings in power plants, industry, and domestic heating in the German Federal Republic in the period from 1969 to 1980. While the primary energy consumption will rise by about 60%, the demand for fossil fuels will increase by about 44%. The pit coal consumption shows a drastic downward trend, while the demand for brown coal will be practically unchanged, and brown coal will be consumed by power plants only in 1980. Great increase in fuel oil and gas consumption will continue. Fuel specific emissions are secured for particulate pollutants and sulfur dioxide only, and the forecasts do not consider anti-pollution measures to be taken in the meantime. Particulate emissions, 50% of which are caused by stationary firings, will decrease by 25% by 1980. The respective shares of power plants, industry, and domestic heating will be 26%, 10% and 15%. Sulfur dioxide emissions from stationary firings, now 88% of the total, will increase by 50%. Against 70% in 1970, 83% of the total fluorine emissions will be caused by stationary firings in 1980, while the corresponding percentage for nitrogen oxides will be 42%. The carbon monoxide emissions from stationary firings will decrease from 2.5 million tons in 1970 to 1 million tons in 1980. Domestic heating and especially the chemical industry will be primarily responsible for organic pollutants. Communal incinerators, now emitting 1000 tons of particulate pollutants and 10,000 tons of sulfur dioxide yearly, will possibly cause local or regional pollution problems. As a result of fuel and waste gas desulfurization, SO2 emissions will drop three million tons below the 1969 level. Due to dust separation techniques, and the use of adequate fuels, a total particulate emission of 230,000 tons, instead of 800,000 tons, is expected.

40471

Baum, F., J. Giebel, and H. Brell

THE ANALYSIS OF GASEOUS POLLUTANTS AT HARD COAL FIRED INDIVIDUAL HEATERS. (Ueber die Erfassung gasfoermiger Schadstoffe bei steinkohlegefeuerten Einzeloefen). Text in German. Gesundh. Ingr. 93(4):102-108, April 1972. 27 refs.

Emissions of sulfur dioxide, hydrogen sulfide, fluorine and oxides of nitrogen from individual hard coal-fired heaters were measured. For determination of the total sulfur and fluorine emission the gas samples (1.67 cu dm/min) were passed through a quartz impinger for soot and tar separation and through two quartz-fritted scrubbers. The impinger and scrubbers contained 75 cu com 1N NaOH, 10 cu cm 3% H2O2 solution, and 5 drops of n-butanol. The same sampling set-up was used for determination of the other pollutants. As absorption fluids, however, 20 cu cm cadmium acetate solution (consisting of 50 g Cd(CH3COO)2.2H2O and 100 cu cm CH3COOH in 850 cu cm H2O) was used for the H2S determination and 120 cu cm Saltzmann solution (25 g sulfanilic acid, 250 mg alpha-naphthalamine, and 250 cu cm CH3COOH in 4 cu dm H2O) was used for determination of NOx. The ash and unburned residues from the combustion were also analyzed. Two types of heaters were examined. In the first one the combustion air enters at the bottom. The waste gases pass the entire fuel charge from bottom to the top. In the second one the combustion air is supplied at various points of the heater. Anthracite briquettes were used for firing. Each combustion test lasted 2, to 3-2/3 hr. The average CO2 concentrations measured in the waste gas during one combustion period of the bottom-fed heater ranged from 4.96% by volume to a maximum of 7.73 vol %. In the second heater they ranged from 6.83 to 7.88 vol %. The concentration of SO2 emissions ranged from 270 to 848 mg/cu m in the first heater and from 495 to 677 mg/cu m in the second. The H2S emission of the bottom heater was considerably higher than that of the multi-point type. The opposite was true for the fluorine and the NOx emission. Based on the number of such heaters in the Ruhr area, their contribution to the total fluorine emission was estimated. Over the half-year of winter, 0.1 to 0.2 microgram fluorine/cu m air comes from domestic heaters.

40600

Gautier, Armand

FLUORINE IS AN ELEMENT ALWAYS PRESENT IN EMISSIONS FROM THE EARTH CORE. (Le fluor est un element constant de emanations du noyau terrestre). Text in French. Compt. Rend., vol. 157:820-825, Nov. 10, 1913. 5 refs.

On-site collection of samples of the gases issuing from the volcano Mt Vesuvius shortly after its eruptions, was started in 1906 in order to establish their fluorine content. In 1913 a sampling method was successfully applied using a 1-liter bottle containing lime, in which a small tube was inserted. The tube was sealed into the bottle neck and protruded well beyond it, so that the bottle could be placed into a suitable fumarole with the tube reaching inside. The fluorine reacted with the lime, and subsequent laboratory tests of this sample showed a fluorine content of 0.110 mg/l gas, corresponding to 0.116 mg hydrofluoric acid or 0.150 mg silicon fluoride. Hydrofluoric acid is estimated to form about 1/8000 part of the total gaseous emission of volcanic fumaroles. Another set of tests was made at a location in Italy where burning gases emerge perpetually through surface cracks. A surface-cooled lead spiral was used on which the water vapor of the emission condensed, permitting collection of the non-condensable gases. These contained carbon dioxide, hydrogen sulfide, ammonia, methane,

oxygen, hydrogen, nitrogen, and traces of argon and helium. The fluorine content of these gases was 0.255 mg, corresponding to 0.268 mg hydrofluoric acid/l gas. Most natural mineral waters contain fluorine. For example, the fluor content of Vichy water is 3.72 mg/l indicating a volcanic origin.

41650

Environmental Engineering, Inc., Gainesville, Fla. and PEDCo Environmental Specialists, Inc., Cincinnati, Ohio

BACKGROUND INFORMATION FOR ESTABLISHMENT OF NATIONAL STANDARDS OF PERFORMANCE FOR NEW SOURCES. GRAY IRON FOUNDRIES. Air Pollution Control Office Contract CPA e0-142, Task 2, 63p., March 15, 1971. 31 refs.

Gray iron foundries produce metal castings by mixing gray iron, pig iron, scrap, and trace additives. The need for particulate controls is great, but average profits of approximately 6.9% do not provide much margin for elaborate controls. New plants seem to be able to economically justify air pollution control; old plants cannot. All devices now in use are designed to control particulate matter. No attempt is made to control nitrogen oxides, and in many cases emission levels have not been determined. The only sulfur dioxide removal is that which takes place during particulate scrubbing. The concentrations of SO2 in top gases from cupola furnaces range from 300 to 470 ppm. Quantitative analyses of fluoride emissions are not reported. Reduced S compounds are not generated in any gray iron processes. Odors originating from the oil, wax, and resins used in molding have not been measured. Uncontrolled cupola melting results in variable opacity which approaches 100%. Electric arc melting also produces a visible plume. Other processes have plumes during charging and when fluxes are added. Four foundries are either planned or in production within stringent particulate emission regulations; eleven foundries operate with 99% efficient controls. Emission limits recommended for new or modified sources are: sulfur oxides-500 ppm, NOx--325 ppm, particulates--0.03g/scf, and visible emissions-less than 10% equivalent opacity. Control methods include venturi scrubbers, fabric filters, baghouses, afterburners, and electrostatic precipitators.

41877

Herrick, R. A.

BACKGROUND INFORMATION FOR ESTABLISHMENT OF NATIONAL STANDARDS OF PERFORMANCE FOR NEW SOURCES: IRON AND STEEL INDUSTRY. Environmental Engineering, Inc., Gainesville, Fla., and Herrick Associates, Reston, Va., Environmental Protection Agency, Division of Abatement Contract CPA-70-142, 107p., March 8, 1971. 40 refs.

Process conditions common in iron and steelmaking are outlined. Emissions of particulates, sulfur oxides, nitrogen oxides, fluorides, polycyclic organic matter, total reduced sulfur, odors, carbon monoxide, and visible emissions are discussed for the processes and the optimum control devices are identified where possible. The basic oxygen furnace and the electric furnace are expected to become the only significant factors in steel production over the next 20 years. There are no BOF installations in the U. S. that do not have air pollution control devices. Control in electric furnace steelmaking is usually handled by canopy heads and sometimes by roof evacuation. The gases from both processes are usually conducted to gas cleaning systems. Recommended standards of performance for the BOF can be written in terms of particulate emissions. A concentration no greater than 0.020 grs/scf should be the maximum. Gas cleaning installations cannot in most cases maintain acceptance specifications. Electric furnace steelmaking should be restricted to a standard of one lb/t of steel produced.

42054

Yahagisawa, Saburo

PUBLIC NUISANCE AND THE PROBLEMS OF EVALUATION. (Kogai to sono keisoku ni okeru mondaiten). Text in Japanese. Hyouunka to Hishitsu Kanri (Stand. Qual. Control), 25(5):14-17, p. 14-17. May 1972.

Fluorine causes injury to humans. Rice and vegetables should not contain fluorine. Lead also enters the human body through food. In the city of Tokyo, 460,000 tons of sulfur oxides per year (1967) are discharged. About 99% is from industry and 1% from automobiles and aircraft. Nitrogen oxides are discharged at the rate of 180,000 tons/yr. About 63.5% is from industry, 35.9% from automobiles, and 0.6% from aircraft. Carbon monoxide is discharged at the rate of 880,000 tons/yr. About 99.7% are from automobiles, 0.1% from industry, and 0.2% from aircraft. The transport and diffusion of pollution are mentioned.

42675

Ministerium fuer Arbeits, Gesundheit und Soziales des Landes Nordrhein-Westfalen, Dusseldorf (West Germany)

CLEAN AIR FOR TOMORROW. UTOPIA OR REALITY? (Reine Luft fuer morgen. Utopie oder Wirklichkeit)? Text in German. 81p., 1972.

Trends in different branches of industry, domestic heating, and transportation and related problems involved in air-pollution control in North Rhine-Westphalia for the period ending 1985 are detailed. Air pollution control as now applied in the chemical industry is not satisfactory. While processes associated with odorous and toxic emissions will increasingly prevail, multi-stage cleaning and systematic measurements by means of recording instruments will be required. Air-pollution control at a rate of 80% will be required for new and existing plants as of 1973 and 1978, respectively. Hydrocarbon and sulfur dioxide emissions should be controlled by the petrochemical industry. The chief pollutants to be controlled in iron and steel works are carbon monoxide, dust, and fluorine compounds; and the specific dust emissions from melting furnaces should be lowered from 1.5 kg to 1.0 kg/ton of iron. Dust emissions in nonferrous metallurgy should be reduced to one third the present limit. Solids, sulfur dioxide, nitrogen oxides, and fluorine emissions from power plants should be reduced. Techniques for desulfurizing fuels and waste gases are available. Fluorine, chlorine, and sulfur compounds are the basic components of emissions from waste incinerator plants. Long-distance heating offers an ideal solution to pollution from domestic heating. The growth of transportation-generated emissions is outlined. Diesel exhaust, though containing no lead and less CO than Otto engine emissions, is nearly as harmful as the latter. Strict new standards for CO, hydrocarbon, and nitrogen oxide emissions should be implemented in 1976 (3 g of CO, 0.3 g of hydrocarbons and 0.25 g of nitrogen oxides per km).

42676

Ministerium fuer Arbeits, Gesundheit und Soziales des Landes Nordrheim-Westfalen, Duesseldorf (West Germany)

NONFERROUS METALLURGY. (NE-Metallerzeugung). Text in German. In: Reine Luft fuer morgen. Utopie oder Wirklichkeit. Moehnesee- Wamel, West Germany, K. ron Saint George, 1972, p. 60-65.

The present situation and future trends in the output and emissions in the nonferrous metallurgy of North Rhine-Westphalia are described. The aluminum industriy, which accounts for more than 50% of the total output of West Germany, will experience rapid growth. The basic pollutants are gaseous fluorine compounds (0.8-1.5 kg/t), aluminum- and fluorine-bearing dust (9-20 kg/t), sulfur dioxide (3-15 kg/t), and carbon monoxide. Aluminum remelting is expected to increase 100% by 1980. Chloride aerosols, metal oxides, and gaseous fluorine compounds are the chief pollutants. Dust separation at a rate of 15% was applied to rotary furnaces in 1970. Dust emissions will decrease from 1320 tons in 1970 to 680 tons in 1980 by lowering the dust concentration to 150 mg/N cu m and 100 mg/N cu m for rotary furnaces and thermal chips treatment facilities, respectively. Gaseous fluorine emissions, 90 tons in 1970, will be reduced to 50 tons in 1980 by applying wet-type gas cleaning. Sulfur dioxide emissions from lead manufacturing will be reduced 90% due to waste-gas desulfurization. The efficiency of SO2 separation at sulfuric acid production facilities is 98%. Lead and zinc emissions, amounting to 350 and 180 tons in 1970, will decrease to 50 tons each in 1975. Sulfur dioxide emissions from copper manufacturing, for which a 2% yearly rate of growth is predicted, will rise from 900 tons in 1970 to 1100 tons in 1980, the waste-gas SO2 concentration being 0.2 g/N cu m. Hydrochloric acid emissions, now 500 tons, will decrease by 50%. While total dust emission will be reduced from 600 to 300 tons, no further reduction in lead, zinc, and copper emissions is possible. The dust emissions from copper alloy manufacturing will be 10% of the 1970 level by 1980, as an upper limit of 50 mg/N cu m will be set in 1973. Sulfur dioxide emissions from zinc manufacturing, for which electrolytic processes are increasingly used, will decrease from 1800 tons in 1970 to about 1500 tons in 1980. The imposition of a maximum allowable dust emission of 50 mg/N cu m in 1973 will result in zinc and lead emissions, now 160 and 40 tons, decreasing to 80 and 20 tons, respectively, despite a growth rate of 40%.

42677

Ministerium fuer Arbeits, Gesundheit und Soziales der Landes Nordrheim-Westfalen, Duesseldorf (West Germany)

STONE AND EARTH. (Steine und Erden). Text in German. In: Reine Luft fuer morgen Utopie oder Wirklichkeit. Moehnesee-Wamel, West Germany, K. von Saint-George, 1972, p. 65-66

The present situation and future trends in the stone and earth industry of North Rhine-Westphalia are described. The general growth in production, as anticipated through 1980, is characterized by a trend toward centralization and large-capacity units with resulting increased specific emissions. The basic pollutants are dust (cement and lime works), fluorine compounds (brickworks and enamel industry) as well as fluorine, chlorine, and metal oxides (glass manufacturing). No changes in the amount and composition of refractory plant emissions are expected, but the proportion of volatile and toxic components (lead, zinc, barium, fluorine, cadmium, boron, selenium, strontium, and chromium) in brickwork emissions will increase. Dust emissions from cement manufacturing plants will decrease slightly over the next few years. Strict supervision of dust separators and recording instruments for automatic dust measurements providing automatic shutoff of rotary kilns in case of emergency, should be required for cement works. High-efficiency separation of dust, fluorine, lead, zinc, and other volatile and toxic substances at brickworks, enamel processing, and wall and floor covering manufacturing plants is necessary. The need for the separation of toxic substances in glass manufacturing is emphasized.

42680

Ministerium fuer Arbeits, Gesundheit und Soziales des Landes Nordrheim-Westfalen, Duesseldorf (West Germany)

THE EMISSION SOURCE INDUSTRY GROUP CHEMISTRY. (Die Emittentengruppe Industrie). Text in German. In: Reine Luft fuer morgen. Utopie oder Wirklichkeit. Moehnesee-Wamel, West Germany, K. von Saint-George, 1972, p. 14-26.

The problem of chemical plant emissions and the necessary measures to be taken during the period ending 1985 are outlined. The chief pollutants emitted by the plants are organic vapors and gases (hydrocarbons and their halogen derivatives, aldehydes, ketones, organic acids, amines, mercaptans, and disulfides), inorganic vapors and gases such as hydrogen sulfide, sulfur dioxide, hydrochloric acid, fluorine compounds as well as toxic dusts of carbides, fluorides, ferroalloys, arsenic, and asbestos. The pollution-control techniques presently applied in the chemical industry may be inadequate to control emissions from new processes. In addition, the rate of growth in production is highest for products involving high emissions, partly of odorous substances. An 80% reduction in emissions from new and old facilities as of 1973 and 1978, respectively, will be required in plastic and synthetic fiber processing, and will apply to old and new pesticides manufacturing plants alike as of 1973. Adoption of the double-contact process in sulfuric acid production reduced SO2 emissions by about 85% decrease in sulfur dioxide emissions, while the nitrogen oxide emission abatement in nitric acid manufacturing due to catalytic hydrogen reduction was 88%. Guidelines regarding emission abatement in chemistry are presented. Odorous and toxic discharges should undergo multistage treatment.

42682

Ministerium fuer Arbeits, Gesundheit und Soziales des Landes Nordrhein-Westfalen, Duesseldorf (West Germany)

IRON AND STEEL. (Eisen und Stahl). Text in German. In: Reine Luft fuer morgen. Utopie oder Wirklichkeit. Moehnesee-Wamel, West Germany, K. von Saint-George, 1972, p. 32-37.

Future trends, air pollution problems, and related measures envisaged for the period ending 1985 in iron and steel manufacturing in North Rhine-Westphalia are outlined. North Rhine- Westphalia is responsible for 70% of the total steel output of West Germany, and further growth is expected. Thomas steel will be fully and Siemens-Martin steel largely replaced by oxygen converter steel by 1980. Dust emissions from ore yards should be controlled. Sintering plants, emitting toxic metal oxides and fluorine and chlorine compounds, should be equipped with proper pollution- control equipment. While blast furnaces, discharging dust, carbon monoxide, nitrogen oxides, sulfur dioxide, and hydrogen sulfide, will prevail during the rest of the decade, processes for direct reduction have been developed. The toxic oxides emitted by oxygen converters call for wet dust separators, electrostatic, and continuously operating tissue filters. The present emission standards should be replaced by stricter ones, and excess-air coefficients of 0.3-0.1 should be applied to abate CO emissions. Electric arc furnaces using the ultra-high-power technique should be covered by total dust separation. A limit value of 50 mg/N cu m and the use of tissue filters should be required. Open-hearth furnaces still in use after 1976 should be equipped with dust separators. The recycling of nontreated dust, containing iron and toxic or volatile compounds of lead, cadmium, zinc, arsenic, manganese, copper, antimony, chromium, and fluorine, should be abandoned. The shutdown of obsolete facilities and improvements in pollution-control techniques are further necessary measures. Special attention should be paid to controlling emissions from ore yards, sintering plants (where combined desulfurization and defluorination techniques should be adopted),

oxygen converters, and blast furnaces. Total dust separation in steel mills should be applied.

42683

Ministerium fuer Arbeits, Gesundheit und Soziales des Landes Nordrhein-Westfalen, Duesseldorf (West Germany)

IRON AND TEMPERING FOUNDRIES. (Eisen- und Tempergiesserelen). Text in German. In: Reine Luft fuer norgen. Utopie oder Wirklichkeit, Moehnesee-Wamel, West Germany, Verlag K. von Saint- George, 1972, p. 38-40.

The present situation and future trends for a period ending in 1980 in the output and emissions of iron and tempering foundries in North Rhine-Westphalia are described. The iron and tempering foundries in North Rhine-Westphalia now account for 44% of the total production volume in West Germany; their growth is expected to slow down during the next decade. The basic pollutants emitted by foundries are dust, sulfur dioxide, and gaseous fluorine compounds, and melting furnaces as well as mold preparation represent the chief emission sources. The maximum allowable specific dust emission from melting furnaces will be lowered from 1.5 to 1.0 kg/t of iron by 1980. New furnaces can be now provided with total dust separation, and the proportion of such furnaces is expected to rise to 20% by 1980. Cupola furnace throat gases contain, on an average, 700 ppm of SO2, corresponding to a specific emission of 1.6 kg/t. A decrease of about 33% in SO2 emission by 1980 can be expected, as coke will be increasingly replaced by natural gas and electricity. The gaseous fluorine emissions are due to fluorine contents in coke (20 ppm) and in dolomite and lime (about 100 ppm). While the fluorine emissions (less than 10 t/year are relatively low), separation techniques with a minimum efficiency of 90% are available. A further decrease in fluorine emissions due to the decreasing proportion of basic hot-blast cupola furnaces is predicted.

42685

Ministerium fuer Arbeits, Gesundheit und Soziales des Landes Nordrhein-Westfalen, Duesseldorf (West Germany)

POWER PRODUCTION. (Energieerzeugung). Text in German. In: Reine Luft fuer morgen. Utopie oder Wirklichkeit, Moehnesee-Wamel, West Germany, K. von Saint-George, 1972, p. 40-51.

Trends in fuel use by thermal power plants and industry in North Rhine-Westphalia and resulting changes in emissions (solids, sulfur dioxide, nitrogen oxides, and gaseous fluorine compounds) are described. Assuming no further improvements in air-pollution control techniques, emissions of solids will increase by 12.5% by 1985, the share of power plants rising from 65% to 72%. Fuel oil will account for 23% of all energy sources. 60-73% increase in nitrogen oxides emissions from 1969 to 1985 is expected, but the contribution of power plants and industry will remain about the same. Sulfur dioxide emissions will increase by 75% from 1.2 million tons in 1969 to 2.1 million tons in 1985. While the proportion of brown coal will be unchanged, it will be consumed almost exclusively by power plants, and the increase in fuel-oil consumption will be most important in industry. Fluorine emissions will be up 17% from 7500 tons in 1969 to 8800 tons in 1985. The contribution of power plants to total fluorine emissions will rise from 84% to 93% as a result of increased brown coal consumption. Optional emission-control measures with regard to solids, SO2, and fluorine emissions are suggested. As dust emission standards are violated as a consequence of continuous operation, the installation of automatic measuring instruments may be necessary. A specific emission of 0.6 kg/ton of heavy oil should be reached by applying centrifugal dust separators, while the dust emission standards for coal firings should be lowered to 50-100 mg/N cu m. In 1969, 64% of the heavy oil consumed contained less than 1% sulfur; in 1985, the proportion of heavy oil with 0.46% S will be 40%. Waste gas desulfurization, resulting in an 80% decrease, will be applied as of 1974, and appropriate means for desulfurizing fuels are available. The total reduction in SO2 emissions by 1985 will be some 30%. Fluorine emissions are expected to decrease from 7500 to 4600 tons in 1985 by 25%. The efficiency of wet separation techniques and alkaline absorbents is 80%.

42731

Safonov, V. N., V. A. Limanskii, V. P. Klyushkin, E. G. Levkov, N. G. Bulgakova, G. I. Il inskaya, N. A. Borisenko, and A. S. Levkova

THE PHYSICAL PROPERTIES AND CHEMICAL COMPOSITION OF DUST FORMED DURING THE PRODUCTION OF ALUMINUM AND SILUMIN. Tsvetn. Metal., 44(4):42-44, 1971. 12 refs. Translated from Russian. Trans-Chem, Inc., Knoxville, Tenn., 6p.

The physical properties and chemical composition of dust have a significant effect on the basic operating character of dust removal devices, and these determine the expediency of using a specific type of dust removal system. Hence, methods for the determination of physical properties and chemical composition of dusts are reviewed. The dispersion of dust particles by particle size at four different plant locations was determined by methods of three dust extractors and an impactor (a multistage jet precipitator). Both methods measure the dispersion of dust particles directly in a gas conduit; the latter, however, gives more reliable results. For measuring the specific electrical resistance of electrolyzer and silumin dust, a device was used in which a dust layer is formed between two filtering surfaces under conditions found in a gas conduit. An advantage of this method for forming the dust layer lies in the fact that it is not necessary to measure the thickness of the dust layer, since it is always constant and equal to the distance between the discs. Regarding chemical composition, fluorine components are of special interest since they are harmful to the attendant personnel as well as being valuable components. Fluorine which is tied up in the form of complex fluorides was determined by a gravimetric method on lead fluorochloride and also by a mercurous and mercuric method using diphenyl carbazone as an indicator. Results are also given for the fluorine determination by a thorium method using alizarin red S as an indicator. Aluminum, calcium, and magnesium were determined by complexometric methods. Silicon was determined photometrically by the dark blue silicomolybdenum complex with elimination of the interference of fluoride ion by boric acid. The basic method for determining the resinous material requires the extraction of polynuclear aromatics with non-fluorescing benzene and then measuring the fluorescence of the extracts. Iron was determined by an orthophenanthroline method after the fluorine was extracted by fusing with potassium pyrosulfate.

42751

Kearney (A. T.) and Co., Inc., Chicago, Ill.

AIR POLLUTION ASPECTS OF THE IRON FOUNDRY INDUSTRY-FEBRUARY, 1971. Air Pollution Control Office Contract CPA 22-69-106, 156p., Feb. 1971. 18 refs. NTIS: PB 204712

Despite recent advancements in the technology of making iron castings, the cupola is still the predominant melting unit employed in the iron foundry industry. Emissions from the industry include metallic oxides, oil vapors, and carbon monoxide

from melting furnace operations; from other dust-producing operations come sand fines, metal dust, and coke dust. Odors and gaseous compounds such as fluoride fumes, vapors, and facing fumes come from both sources. The lack of correlation between standard furnace design factors and emissions levels requires that the explanation for the wide variance in type and quantity of emissions lie with cupola operating factors, rather than cupola design. Operating factors are broken down into two distinct groups: methods of operations, such as blast rate and temperature, type of lining, and operating variables of the afterburner; and the quality of charge materials, including metal to coke ratio, use of oxygen or natural gas, and the use of briquettes. Recommended practices for testing particulate emissions from cupolas are also included. Control devices include centrifuges, scrubbers, fabric filters, afterburners, preheaters, electrostatic precipitators, furnace hoods, and ventilation.

43014

BACKGROUND INFORMATION FOR ESTABLISHMENT OF NATIONAL STANDARDS OF PERFORMANCE FOR NEW SOURCES. PRIMARY SMELTING OF COPPER, LEAD, AND ZINC. Environmental Engineering, Inc., Gainesville, Fla. and PEDCo Enviromental Specialists, Inc., Cincinnati, Ohio, Air Pollution Control Office Contract CPA 70-142, Task 2, 82p., March 15, 1971. 33 refs.

The primary nonferrous smelting industry consists of smelting copper, zinc, and lead bearing ores. Because of the high sulfur content, sulfur dioxide emissions are copious. In 1966, nonferrous smelters emitted approximately 3.8 million tons of SO2, or 12% of the total SO2 emissions in the nation. The main processes in the extraction of copper, lead, and zinc from their ores are dressing or concentrating, roasting, sintering, smelting and refining carried out in different types of equipment, depending upon the nature of the ore and the particular plant design. Emissions from primary smelters include, in addition to SO2, nitrogen oxides, solid particulates including toxic metals, and minor amounts of fluorides. Primary control emphasis is placed upon sulfur dioxide and particulate emission. Control technology, including electrostatic precipitators, fabric filters, SO2 removal processes (contact, alkaline additive, absorption, Claus, and scrubber methods), and mist eliminators, is examined. Most of the SO2 source streams are of sufficient concentration to justify sulfur value recovery. Smelting operations which control SO2 emissions to a high degree, both those presently in use and projected designs for the future, are described. Specific regulations currently pertaining to emissions from primary nonferrous smelters are summarized, and the growth of the industry is projected to the year 1980.

43270

Environmental Protection Agency, Research Triangle Park, N. C., Office of Air Programs

FOOD AND AGRICULTURE INDUSTRY. In: Compilation of Air Pollutant Emission Factors. OAP Pub-AP-42, p. 6-1 to 6-15, Feb. 1972. 40 refs. NTIS: PB 209559

Food and agricultural product processing, including refining, preservation, product improvement, storage and handling, packaging, and shipping are reviewed. Particulate emission factors are given for: alfalfa dehydrating, coffee roasting, cotton ginning, grain handling and processing, fermentation, fish processing, meat smokehouses, nitrate fertilizers, phosphate fertilizers, starch manufacturing, and sugar cane processing. Control methods include the use of: baghouses, afterburners, cyclones, activated-carbon adsorbers, scrubbers, and electrostatic precipitators. Particulates, carbon monoxide, hydrocarbons, nitrogen oxides, fluorides, ammonia, aldehydes, hydrogen sulfide, organic acids, and amines are some of the pollutants emitted from food and agriculture industries.

43272

Environmental Protection Agency, Research Triangle Park, N. C., Office of Air Programs

MINERAL PRODUCTS INDUSTRY. In: Compilation of Air Pollutant Emission Factors. OAP Pub-AP-42, p. 8-1 to 8-24, Feb. 1972. 72 refs. NTIS: PB 209559

Processing and production of various minerals are discussed. Particulate emission factors are given for: asphalt batching, asphalt roofing, brick and clay product manufacturing, calcium carbide manufacturing, castable refractories manufacturing, cement manufacturing, ceramic clay manufacturing, clay and fly-ash sintering, coal cleaning, concrete batching, fiberglass manufacturing, frit manufacturing, glass melting, gypsum processing, lime manufacturing, mineral wool processing, perlite manufacturing, phosphate rock processing, and stone quarrying and processing. Emissions occur during processing and throughout handling and storage. Control equipment used includes cyclones, scrubbers, and fabric filters. Particulates, carbon monoxide, hydrocarbons, sulfur oxides, nitrogen oxides, and fluorides are the major pollutants.

43403

Stoiber, Richard E. and William I. Rose, Jr.

THE GEOCHEMISTRY OF CENTRAL AMERICAN VOLCANIC GAS CONDENSATES. Geol. Soc. Am. Bull., 81(10):2891-2912, Oct. 1970. 49 refs.

Chemical data on fumarolic exhalation from high-temperature fumaroles were obtained from 132 gas condensates sampled at six Central American volcanoes. The data are from sufficiently varied locations and cover a long enough time span to permit generalizations regarding the variations in quantity of the seven components for which analyses were made, namely, chlorine, fluorine, sulfate radical, calcium, magnesium, sodium, and potassium. Fumaroles on lava flows have chloride-rich emanations, and fumaroles at active central vents have high SO4. Quantitative data suggest decrease of Cl/SO4 ratio at fumaroles at or near active vents before an eruptive period and a rise in the ratio afterward. Regular observations of trends of Cl/SO4 in condensates from high-temperature fumaroes near central vents appear to allow prediction of the onset of a new eruptive period. The seasonal rains in Central America aid in confirming the effect of groundwater dilution on concentration. Cl and F concentrations and Cl/F, unlike SO4 or Cl/SO4, are time and temperature dependent. Changes in concentration with time or temperature appear due to increased ground-water dilution, reduction in the volume of chlorine from the magmatic source with time and, for F, extraction by reaction with the wallrock. Alkalis and alkaline earths appear to be the products of reaction with the wallrock. Part of the K and Na, whose chlorides, unlike those of Ca and Mg, are volatile, appears to have a magmatic source. Estimates of the Na/K ratios in emanations from basaltic to dacitic magma cover a range of 0.5 to 3.0. Suggestions are made for improved data collection when an appropriate opportunity is offered. (Author summary modified)

43816

Hazumi, Kunihiko

ENVIRONMENTAL POLLUTION BY SULFUR PROCESSING FACTORY WASTE GAS AND ITS CONTROL TREATMENT. (Seirin kojo haigasu ni yoru kankyo osen to jogai taisaku). Text in Japanese. Fukushima-ken Eisei Kenkyusho Kenkyu Hokoku (Fukishima Prefect. Inst. Public Health, Rept.), 19(2):39-41, June 1971. 9 refs.

The hydrogen fluoride and phosphorus content in flue gases from a yellow phosphorus manufacturer are determined by the JIS method and the molybdenum blue method, respectively. An air sampler is used for the gas sampling by placing 10 ml of N/100 potassium permanganate in a gas impinger and sampling at a rate of 2 l/min. Results show that the HF content in flue gas from a melt phosphorus fertilizer plant is 10.2 ppm, and that from a yellow phosphorus plant is 6.29 to 12.72 ppm. The phosphorus content in flue gas from the melt phosphorus fertilizer plant is 0.22 to 0.35 mg/cu m, that from a phosphoric acid fertilizer plant is 10.4 to 37.2 mg/cu m, and that from the yellow phosphorus plant is 0.54 mg/cu m as an average of two stacks. Methods that have been used for the control of the two pollutants are described.

44490

Environmental Engineering, Inc., Gainesville, Fla.

BACKGROUND INFORMATION FOR ESTABLISHMENT OF NATIONAL STANDARDS OF PERFORMANCE FOR NEW SOURCES: PRIMARY ALUMINUM INDUSTRY. Environmental Protection Agency, Div. of Abatement Contract CPA-70-142, Task Order 2, 55p., March 15, 1971. 25 refs.

Aluminum processes are reviewed, and emissions from primary aluminum smelters are listed. Sulfur oxides are generally considered to be an insignificant air pollution problem in the smelting process. Nitrogen oxides are also insignificant, except as developed in ancillary activities. No information is available on the emission of alumina dust. Fluorides are the emissions of greatest concern. Total fluoride emission increases with temperature. Total fluoride emissions from the best run plants are reported at 2.3 to 6 lb/t of aluminum with 16 to 48% in the gaseous form. Particulates from these same sources range from 9 to 50 lb/t of aluminum. Some gaseous hydrogen fluoride is evolved. Reduced sulfur compounds have not been found. Odors are not thought to present a problem. The recommended standard for gaseous and particulate fluorides is 2.4 lb/t Al; total particulates, 5 lb/t Al; and visible emissions, Ringelmann No. 1.

44566

American Assoc. for the Advancement of Science, Washington, D. C., Air Conservation Commission

SUMMARY OF THE FACTS. In: Air Conservation. AAAS Pub. 80, p. 23-46, 1965.

Sources, atmospheric behavior and health effects are reviewed for carbon dioxide, carbon monoxide, sulfur dioxide, sulfuric acid, hydrogen sulfide, nitrogen oxides, hydrogen fluoride, ethylene, olefins, aldehydes, mercaptans, solvents, dust, soot, insecticides and herbicides, and radioactive materials. Factors affecting the transport of pollutants are particle size, gravity, turbulent diffusion, aggregation and condensation, lapse rate, and temperatur inversion. Pollutants are removed from the atmosphere by rain, snow, oxidation, and washout. Pollutant control is achieved by elevated stacks, removal of pollutants from effluent streams, and modification of industrial processes, raw materials, and fuels. The importance of scientific investigation, dissemination of information, public opinion leadership, and effective legislation are discussed.

44605

Less, L. N. and J. Waddington

THE CHARACTERISATION OF ALUMINUM REDUCTION CELL FUME. Preprint, American Inst. of Mining, Metallurgical, and Petroleum Engineers (AIME), New York, N. Y., 10p., 1971. (Presented at the American Institute of Mining, Metallurgical, and Petroleum Engineers, Annual Meeting, New York, Feb. 26-March 4, 1971.)

The nature of the fume emitted by aluminum reduction cells with prebaked anodes was investigated. The gaseous and particulate contributions under different conditions of cell operation were assessed, and the constitution and particle size distribution of the dust determined by chemical and X-ray examination, together with optical and scanning electron microscopy. Approximately 50% of the fluorine emission is in the form of hydrogen fluoride. The particulate material exhibits a double size distribution with one fraction consisting substantially of dust greater than 5 micron diameter and the other of fine material considerably less than 1 micron diameter. The principal components of the coarse fraction are alumina, carbon, and frozen droplets of cryolite; the fine fraction appears to consist mainly of condensed fluoride vapor approximating in composition to chiolite (5NaF.3AlF3). This fine particulate material accounts for about 35% of the total fluorine emission from the cells. Some parallel observations on the character of the fume evolved from vertical stub Soderberg cells are also discussed. The principal differences are that approximately 90% of the fluorine is present as HF, and that the dust, and particularly the alumina content, is lower than from a prebake cell. (Author abstract)

44681

Jacob, K. D., H. L. Marshall, D. S. Reynolds, and T. H. Tremearne

COMPOSITION AND PROPERTIES OF SUPERPHOSPHATE-VOLATILIZATION OF FLUORINE IN SUPERPHOSPHATE MANUFACTURE. (Ind. Eng. Chem., 34(6): 722-727, June 1942.

Production of ordinary superphosphate results in the volatization of fluorine which is allowed to escape to the atmosphere or is absorbed in water. At some plants that manufacture ordinary superphosphate, as well as at some that manufacture double superphosphate, the volatilized fluorine is recovered as hydrofluosilicic acid and is marketed chiefly as sodium fluosilicates. In the production of ordinary superphosphate, 11 to 42% of the fluorine in the phosphate rock is volatilized during the mixing and denning operations. The percentage volatilization of the fluorine tends to decrease with an increase in the phosphorous content of the rock. With rocks of the same phosphorous content, the fluorine volatilization is somewhat higher from Tennessee brown rock than from Florida land pebble. Studies of the distribution of fluorine among the calcium sulfate waste and the intermediate and final products of the manufacture of double superphosphates by the wet method showed cumulative volatilizations of fluorine ranging from 36 to 54% of the total fluorine in all the phosphate rock used throughout the process. (Author abstract modified)

45145

American Assoc. for the Advancement of Science, Washington, D. C., Air Conservation Commission

POLLUTANTS AND THEIR EFFECTS. In: Air Conservation. AAAS Pub. 80, p. 60-194, 1965. 267 refs.

The sources, reactions, atmospheric concentrations, plant, animal, and property damage effects, measurement, control, and global implications are reviewed for sulfur and its com-

pounds (sulfur oxides, mercaptans, and hydrogen sulfide), carbon monoxide, carbon dioxide, nitrogen oxides (nitric oxide and nitrogen dioxide), photochemicals (hydrocarbons, aromatics, and aldehydes), particulate matter, lead and other metals, fluorides, radioactive pollutants, and economic poisons such as pesticides and fungicides. The epidemiological relationship between lung cancer and exposure to air pollutants is discussed. Incomplete combustion of organic materials is a primary source of airborne carcinogenic aromatic hydrocarbons. Agricultural uses, including ground and aerial application and nonagricultural uses of economic poisons are described. Radioactive contamination of the atmosphere results from the reactor fuel cycle; the use of nuclear energy as a source of propulsive power,; the use of radioisotopes in industry, agriculture, medicine, and scientific research; and from nuclear weapons testing. The radionuclides that are present in the radioactive debris from fallout and that have the greatest significance in terms of their effects on man are strontium-90 and strontium-89, which are beta emitters and principally irradiate the skeleton; cesium-137, which is a beta-gamma emitter and concentrates in soft tissues, resulting in internal whole-body irradiation; carbon-14, a beta-gamma emitter, which accumulates in the body and delivers whole-body irradiation; iodine-131, a beta-gamma emitter, which concentrates in the thyroid gland; and a number of short-lived fission products that produce extermal whole-body irradiation when deposited on the ground. The behavior of these materials in the food chain is examined. Monitoring systems and countermeasures for radiation pollution are described.

45858

Lukey, Michael E. and M. Dean High

EXHAUST GAS CONVERSION FACTORS. Preprint, Air Pollution Control Assoc., Pittsburgh, Pa., 16p., 1972. (Presented at the Air Pollution Control Assiciation, Annual Meeting, 65th, Miami, Fla., June 18-20, 1972, Paper 72-88.)

The exhaust gas parameters from 76 combustion and industrial sources are given including fuel combustion processes, refuse incineration, mineral industries, chemical industries, metallurgical processes, pulp mills, and refineries. The main objective of the study was to define a relationship of the exhaust gases being emitted, to the process weights. Each of the 76 industrial source factors includes a process description, the potential air contaminants, operating time, abatement equipment, an input-output relationship, and the exhaust gas parameters: gas flow rate, gas temperature, gas velocity, and stack height. An attempt was made to relate the exhaust gas parameters to an input or output quantity. Thus by knowing the production rate of a plant, one can use these exhaust gas source factors and pollutant emission factors to obtain engineering estimates of specific plant emission and its community impact through modeling. Sources include coal, oil, natural gas, and wood combustion, incineration; burners; chemical processes such as ammonia, carbon black, chlorine, hydrofluoric acid, paint, phosphoric acid, plastics, ink, soap, sulfuric acid, synthetic fibers, and rubber production; food and agricultural processes; primary metallurgy; steel, lead, zinc, and aluminum production including sintering, blast furnaces, electric furnaces, and open hearth furnaces; petroleum refining, pulp mills; dry cleaning; and surface coating.

46119

Bourbon, P., J. Alary, and F. Alengrin

STUDYING FLUORINE EMISSIONS FROM PHOSPHORIC ACID AND FERTILIZER MANUFACTURING SOURCES. (Etude des emissions fluorees lors de la fabrication de l acide phosphorique et d engrais). Text in French. Tribune CEBEDEAU (Centre Belge Etude Doc. Eaux), 25(343-344): 321-324, June-July 1972.

Emission measurements were carried out around a phosphoric acid and fertilizer manufacturing plant. The waste gases from the phosphoric acid manufacturing plant, containing 3.8% fluorine, were cleaned by scrubbers at an efficiency of 99%. The daily F discharge was 1.4 kg. The fluorine to silicon ratios ranged from 2.7 to 3.2. The phosphorus pentoxide concentrations were below 3 mg/cu m. The fluorine emissions from the ammonium phosphate production were in a range of 2-50 mg/cu m with an average of 16.4 mg/cu m corresponding to a daily output of 50 kg. Ammonia and its derivatives bound in phosphate, fluoride, and fluosilicate were discharged at a rate of 2 t/day corresponding to a concentration of 550 mg/cu m (50 to 2000 mg/cu m). The superphosphate manufacturing plant, of a capacity of 400 t/day, discharged 150,000 cu m of waste gas with an F concentration of 22.5 mg/cu m daily, corresponding to a daily emission of 80 kg. The superphosphate granulation plant discharged F mostly in the form of hydrofluoric acid, at a rate of 80 kg/day; it was served by three cyclones to reduce the discharge rate to 15 kg/day. The fluorine concentrations measured within a 2-kilometer-radius around the plant ranged from zero to 30 micrograms/cu m. Necrotic manifestations in the vegetation were observed. Fluorine, along with sulfur dioxide and ammonia emissions, may be responsible for the elevated fog frequency in the neighborhood.

46558

Hoshino, Yoshiro

THE MAIN SOURCES OF ENVIRONMENTAL POLLUTION IN THE INLAND SEA AREA. (Seto Naikai chiiki ni okeru shuyo na kankyo osengen). Text in Japanese. In: The Inland Sea - Report on General Investigations of Pollution. (Seto Naikai - osen sogo chosa hokoku). General Investigation Committee on the Inland Sea Pollution, Tokyo (Japan), p. 390-414, 1972.

The main pollutant sources in the coastal areas of the Inland Sea are discussed by type of industry. Storage by the Fukuyama Plant of Japan Steel Pipe of approximately 23 million tons of iron ore, coal, and lime creates a tremendous amount of dust. The Mizushima Plant of Kawasaki Ironworks stores 15 million tons of material, and the nearby village of Takashima has a serious problem of dust pollution. The Fukuyama Plant produces approximately 24,000 tons of sulfur dioxide annually at its sintering plant from the iron ore alone. In addition, at least 650,000 tons of SO2 from coal and at least 40,000-50,000 tons from fuel pollute the area. A copper refinery plant that annually produces 100,000 tons requires 500,000 tons of copper and emits 20,000-30,000 tons of SO2. The principal air pollutant produced at an aluminum plant is hydrogen fluoride created during aluminum electrolysis. The Sumitomo Chemical Toyama Plant reportedly pollutes an area of 3-kilometer radius around the factory. The Mizushima Plant of Japan Mining produces approximately 21,000 tons of SO2 annually, and the Mitsubishi Petroleum Mizushima Plant produces 19,000 tons. Together with the thermal electric plants of the Chugoku Electric and Kawasaki Iron in the Mizushima area, the total SO2 emitted from the thermal electric plants in the Mizushima area is approximately 92,000 tons annually. The total sum of SO2 from the thermal electric plants and iron refineries is approximately 240,000 tons in the area.

46925

Gasiorowski, Kurt

WASTE GAS COMPOSITION AND MAINTENANCE OF CLEAN AIR WITH OIL AND GAS HEATING. (Abgasfragen und Luftreinhaltung bei Oel- und Gasfeuerungen). Text in German. VDI (Ver. Deut. Ingr.) Z. (Duesseldorf), 114(14):1043-1047, Oct. 1972. 16 refs.

The majority of substances composing fuel oils are formed by carbon and hydrogen. They also contain organic compounds such as sulfur, nitrogen, oxygen, and various metals. The combustion gases contain sulfur in organic or inorganic form such as mercaptans, hydrogen sulfide, or carbonyl sulfide. The problem of sulfur dioxide emission is discussed. The most widely used method of avoiding these emissions is the desulfurization of fuels. In the German Federal Republic this method is practiced with natural gases and with light fuel oils. The sulfur production from these two sources will exceed 500,000 tons/yr by the mid-seventies. The desulfurization of heavy fuel oils has been tested since 1967 in experimental plants on a commercial scale. The results so far have not been very encouraging but give hope. The emission of ash plays a negligible role with light and heavy fuel oils and fuel gas. Also, the fluorine emissions by these fuels are low; light fuel oil and natural gas contain no fluorine; heavy fuel oil is assumed to contain 1 to 10 mg/kg. There are also process-dependent emissions such as carbon monoxide, soot, fly ash, hydrocarbons, polynuclear aromatics, and the oxides of nitrogen. The most important cause for such emissions is the lack of air or oxygen. Another cause is an air surplus. Measures for reducing these emissions are reviewed, e.g., the proper fuel oil for the size of the heating system, good adjustment of fuel oil atomization, good agreement between the shape of the flame and the shape of the combustion chamber, proper supply of combustion air, and avoidance of temperature drops below the dew point.

47048

Moll, Walter

PROBLEM: REFUSE INCINERATION. (Problem: Muellverbrennung). Text in German. Staedtehygiene (Uelzen/Hamburg), no. 10:236-237, Oct. 1972. 8 refs.

According to recent investigations, the incineration of refuse can endanger human health. The incineration plant at Hamburg, for example, emits 6 million cu m of flue gases daily containing about 900 kg of very fine-grained dust. The dust particle surface absorbs metal chlorides and organic compounds causing cancer if the dust penetrates into the lungs. Besides the dust, great quantities of harmful gases like carbon monoxide, hydrochloric acid, heavy metal chlorides, and many organic compounds are emitted from incineration plants. These gases are only completely destroyed if burned at temperatures exceeding 1400 C, which, however, are not reached in incineration plants, since the linings of the furnaces would be seriously damaged. Polychlorinated biphenyls which are frequently used in hydraulics, constructional engineering, and as softener in lacquers raise a new problem since they are not decomposed by burning and have a dangerous biological effect when being emitted. Another great problem arises by the increasing production of substances containing fluorine, such as teflon, which forms highly toxic gases when being burned. Considering the problems connected with refuse incineration, emphasis should be laid on research work in the recycling and sanitary landfill field.

47061

Dobbs, C. G.

FLUORINE, THE FAVOURED POLLUTANT. Protectio Vitae, no. 3:105-109, 1972. 37 refs.

The annual average fluorine content in rainwater of 0.16 mg/l was raised to a range varying from 0.28 mg/l to 10 mg/l in the neighborhood of industries using fluorine. Test plants with a normal F-ion content of 7-15 mg/kg dry weight could have had as much as 500 to 1850 mg/kg in the polluted areas. Also, a direct correlation between the F-ion level in the rainwater and in the test plants was found. A much higher F-ion content in food plants such as lettuce, leeks, parsley, and various fruits grown in industrial areas was found. The hazards of pollution are of two main types - intensive and extensive. The intensive type usually causes acute and visible damage which result, eventually, in some sort of action to eliminate it. Unfortunately, the action often consists in the transformation of intensive into extensive pollution, as with the high stack policy. All it did was to spread the pollutant over a wider area where its effects will be more difficult or impossible to distinguish from those of other factors. A case in point is the large aluminum plant near Holyhead in North Wales. At the Public Enquiry in 1968 the estimated total emission was 928 lbs/day of fluoride. By 1970 this amount had risen to 1436 lbs. The stack was raised from 300 ft to 400 ft and provided with an additional rise from an internal hot pipe from the anode plant.

47143

Stanford Univ., Calif., Stanford Workshop on Air Pollution

AIR POLLUTION IN THE SAN FRANCISCO BAY AREA. (FINAL REPORT). 385p., 1970. 72 refs.

The state of the air pollution problem in the San Francisco Bay area, with respect to the chemical nature, potential effects, sources, and occurrence of air contaminants, administrative aspects, public affairs, air pollution control devices, and research projects, is examined. The major pollutants include particulate matter; sulfur oxides; carbon monoxide; nitrogen oxides; organics (hydrocarbons); photochemical reaction products, e.g., smog, ozone, and peroxyacyl nitrates; and other pollutants such as lead particles, hydrogen sulfide, fluorides, and various metals. The sources considered included automobiles, petroleum operations, chemical plants, metallurgical and mineral industries, combustion operations, electric power production, and organic solvent users. Complete air quality and emission data are included. Other sources of pollution, collectively significant, consist of automobile service stations, incineration, domestic heating, agricultural burning, and non-highway transportation. The administration of the control district and citizens groups were examined and rated; suggested plans for future activities are presented.

47188

Bureau of Mines, Washington, D. C.

BUREAU OF MINES RESEARCH 1971. A SUMMARY OF SIGNIFICANT RESULTS IN MINING METALLURGY AND ENERGY. 61p., 1971. GPO

Significant results of the Bureau of Mines research programs in mining, metallurgy, and energy are presented. The contents include coal mine health and safety, explosives research, mine reclamation and restoration, rock properties and behavior, mine planning and stabilization, strip mining operations, drilling equipment and techniques, mineral processing, hydrometallurgy, pyrometallurgy, recycling, adaptive metallurgy, coal, petroleum, natural gas, and oil shale research, and environmental and solid waste research. With specific applica-

tion to the field of air pollution, data are presented on respirable dust concentration control in mines; fluorine recovery during phosphate processing; sulfur dioxide removal and sulfur recovery from smelter operations; smokeless automobile incineration; development of non-polluting fuel; and modified or improved methods for fuel combustion and solid waste disposal.

47410

Jansen, Peter, Siegfried Jordan, and Wolfgang Schikarski

COMPARATIVE MODEL THEORY OF ATMOSPHERIC POLLUTION BY POWER PLANTS. (Vergleichende Modelltheorie der atmosphaerischen Schadstoffbelastung durch Kraftwerke). Text in German. Staub, Reinhaltung Luft, 32(11):454-458, 1972. 33 refs. (Presented at the Colloque IRCHA sur les Atmospheres polluees, 10th, Paris, France, May 3-5, 1972.)

On the basis of maximum permissible concentrations, simplified box models were developed to compare air pollution from nuclear- and fossil-fueled power plants. Assuming exponential decay of the pollutants, body burden functions for the main pollutants from different types of power plants were calculated and compared. These pollutants include dust, sulfur dioxide, nitrogen oxides, fluorine compounds, xenon(133), and krypton(85). The pollutant body burden of nuclear power plants was found to be much smaller than that of fossil fueled plants. Power stations fueled with natural gas gave relative body burdens which are smaller than those from power plants fueled with hard coal, brown coal, and oil, but larger than those from nuclear power plants. Krypton(85) released from reprocessing plants was the main pollutant of nuclear power systems.

47945

Niigata Prefectural Health Research Inst. (Japan) and Niigata Prefectural Research Inst. for Public Nuisances (Japan)

INVESTIGATIONS OF FLUE DUST AND FLUORINE, AUTOMOTIVE EXHAUST GAS AND OTHERS. (End nado no baijin, fusso chosa, hoka). Text in Japanese. In: 1971 Annual Report. No. 6. p. 40-44, Aug. 1972.

The dust and fluorine content of flue gases were investigated at 30 spots in four companies operating in Niigata Prefecture to find that they were all below the regulatory criteria. Atmospheric concentration of sulfur oxides in the Yahiko-mura area was measured at seven selected spots for total of 70 times. The values obtained were generally very low. At the Aoumi-cho and Niigata Higashi-ko districts, suspended dust was measured by hi-volume samplers three times a month for total of 108 times. Analysis of automotive exhaust gas was conducted at Joetsu City, Kameda Town, and Kashiwazaki City where automotive traffic is generally congested. In a few selected districts of Niigata City, sulfur dioxide in the atmosphere was measured by the pararosaniline method, fluoride by the alkaline filter paper method, and suspended dust by the hi-volume sampler method, for 4 days from July 5 to July 8. An air pollution survey for the old Naoetsu district was also conducted. Other investigations performed during the year include surveys on effects of air pollution on plants, surveys on emission sources of harmful substances, and radioactivity in rain, suspended dusts, soils, and water. The results obtained from these investigations are tabulated.

47954

Just, Jan

ATMOSPHERIC AIR POLLUTION AS AN ECONOMIC, NATURAL SCIENCE, AND HEALTH PROBLEM. (Zanieczyszczenie powietrza atmosferycznego jako problem gospodarczy, przyrodniczy i zdrowotny). Text in Polish. Gaz, Woda Tech. Sani. (Warsaw), 46(6):195-198, 1972. 1 ref.

Air pollution sources include exhaust gases and particulates generated by technological processes during combustion; gases and dust from industrial installations; gases and dusts drawn from production areas and storage places; and pollutants produced by open-air sources, such as dumps, storage sites, heaps, and vehicles. The pollutants exist as gases, fog, or particulates in the atmospheric air. They are aerosols (0.1 micron) or suspended particles (larger than 0.1 micron). They can represent a hazard to human health. The speed of dust deposition depends on the grain diameter. It varies between 54,900 cm/sec for dust with a 100-micron diameter to 0.000059 cm/sec for 0.1 micron. The pollutants most frequently found are sulfur dioxide and its compounds (in Poland 2,500,000 ton/yr in concentrations ranging from 0.01 to over 1 mg/cu m). Sulfur dioxide and its derivatives are highly corrosive, so at 0.5 mg/cu m in England they cause great economic losses. Nitrogen oxides are generated by electrical discharges and high temperature combustion processes (combustion motors). Their concentration in air should not exceed 0.2 mg/cu m. Fluoride and its compounds are generated by facilities producing phosphates, aluminum works, the glass industry, and the ceramic industry. They are highly poisonous, and their concentration should not exceed 0.01 mg/cu m/day. Carbon monoxide is generated by incomplete burning of combustibles containing carbon. Its concentration should not exceed 10 mg/cu m. Carbon dioxide is generated by the natural processes of rotating, breathing, and combustion. Its concentration is 620 mg/cu m. A constant increase by 1.37 mg/cu m/yr has been observed. The permanent danger of polluting the troposphere is imminent. The methods of atmospheric air protection are planning, technological, technical, and administrative-educational.

47959

Bundesministerium des Inneren, Bonn (West Germany), Projekt gruppe Umweltchemikalien und biozide

CONTRIBUTION OF THE ENVIRONMENTAL CHEMICALS AND PESTICIDES PROJECT GROUP. (Beitrag der Projektgruppe Umweltchemikalien und Biozide). Text in German. In: Materialien zum Umweltprogramm der Bundesregierung 1971. Umweltplanung. Lower House of Parliament, 6th Session, Document 6/2710, p. 65-107, Oct. 1971.

Environmental aspects of the use of fertilizers, pesticides, and other environmental chemicals, and of exhaust lead emissions are reviewed. The amount of automobile-generated lead emissions in West Germany is estimated at 7000 t/yr in 1970. The lead concentrations in the air in places with high traffic density ranges from 0.5 to 15 micrograms/cu m, against a background concentration of 0.03-0.1 micrograms/cu m. The sedimentation rate of lead ranged from 0.18 to 4.8 mg/sq m/day in the 1967-1968 period. Correlation between the lead concentrations in plants and their distance from highways was determined. The maximum allowable workplace lead concentrations are 0.200 mg/cu m for metallic lead, 0.015 mg/cu m for lead arsenate, and 0.75 mg/cu m for both lead tetraethyl and lead tetramethyl. Emissions of nitrogen dioxide, sulfur dioxide, fluorine, pesticides, mercury, cadmium, fuel additives, and other pollutants are discussed.

47962

Bundesministerium des Inneren, Bonn (West Germany), Arbeitsgruppe Montanindustrie

CONTRIBUTION OF THE MINING INDUSTRY PROJECT GROUP. (Beitrag der Arbeitsgruppe Montanindustrie). Text in German. In: Materialien zum Umweltprogramm der Bundesregierung 1971. Umweltplanung. Lower House of Parliament, 6th Session, Document 6-2710, p. 357-394, Oct. 1971. 17 refs.

Environmental protection-related problems and objectives in the mining industry are outlined. The potassium salt industry has invested 6 million dollars for the control of sulfur dioxide and dust emissions over the last 10 years. Coke gases from brown coal cooling are partly desulfurized to a residual hydrogen sulfide content of 2 g/cu m and to an organic sulfur content of 0.5 g/cu m. The afterburning of carbon monoxide by auxiliary air, and the partial replacement of coke by natural gas or oil in cupola furnaces are among the emission control possibilities of practical interest. The decreasing proportion of open-hearth furnaces in the iron and steel industry is of a beneficial effect regarding emissions. A three-stage steel manufacturing process now under study, which consists of agglomeration, direct reduction, and electric smelting, will also reduce emissions. Dry absorbents are best for binding fluorine emissions from nonferrous metallurgical plants where the SO2 emitted should be converted into marketable sulfur instead of into sulfuric acid. Electrostatic dust precipitators, tissue filters, and venturi scrubbers are used for dust separation in the ferroalloy industry.

47963

Bundesministerium des Inneren, Bonn (West Germany), Arbeitsgruppe Chemische Industrie

CONTRIBUTION OF THE CHEMICAL INDUSTRY PROJECT GROUP. (Beitrag der Arbeitsgruppe Chemische Industrie). Text in German. In: Materialien zum Umweltprogramm der Bundesregierung 1971. Umweltplanung. Lower House of Parliament, 6th Session, Document 6/2710, p. 395-461, Oct. 1971.

Environmental protection-related problems and objectives in the chemical industry of West Germany are reviewed. The total sulfur dioxide, nitrogen oxide, carbon monoxide, chlorine, hydrochloric acid, fluorine compound, hydrocarbon, and dust emission concentrations in 1969 were 60,000, 25,000, 50,000, less than 100, 1000, 200, 100,000, and 10,000 tons, respectively. Qualitative and quantitative determination methods and emission standards for various pollutants, and means of pollution control (such as cyclones, electrostatic dust precipitators, tissue filters, scrubbers, fiber filters, and thermal, catalytic, and wet incinerators) are reviewed. Problems and projects in pollution control area in various branches of the chemical industry (inorganic raw materials, petroleum and natural gas, organic intermediaries, organic paints, monomers, pesticides, pharmaceutical products, detergents, pulp and paper, leather, textiles, starch, sugar, and beer) are outlined.

47965

Bundesministerium des Inneren, Bonn (West Germany), Arbeitsgruppe Glas, Keramik, Steine und Erden

CONTRIBUTION OF THE GLASS, CERAMICS, STONE AND EARTH WORKING GROUP. (Beitrag der Arbeitsgruppe Glas, Keramik, Steine und Erden). Text in German. In: Materialien zum Umweltprogramm der Bundesregierung 1971. Umweltplanung. Lower House of Parliament, 6th Session, Document 6/2710, p. 509-520, Oct. 1971. 5 refs.

Problems and efforts in the glass, ceramics, stone, and earth industries in the environmental protection area are outlined. The contribution by this branch of industry to pollutant emissions in 1969 was 70,000 tons of particulate matter. 50,000 tons of sulfur dioxide, and 200 tons of gaseous fluorine compounds. The specific dust emission from cement works is about 0.11% of the cement output, compared to 3.5% in 1950. While it is possible to limit dust emission concentrations to 150 mg/N cu m by means of electrostatic and mechanical dust separators, there are no economically acceptable solutions to the SO2 and F emission problems. The extensive use of low-sulfur fuel for glass smelting has a positive effect regarding SO2 emissions.

47966

Bundesministerium des Inneren, Bonn (West Germany), Arbeitsgruppe Energie

CONTRIBUTION OF THE ENERGY WORKING GROUP. (Beitrag der Arbeitsgruppe Energie). Text in German. In: Materialien zum Umweltschutzprogramm der Bundesregierung 1971. Umweltplanung. Lower House of Parliament, 6th Session, Document 6/2710, p. 521-547, Oct. 1971.

General environmental problems of energy production are reviewed. Thermal power plants emit varying amounts of dust, sulfur dioxide, nitrogen oxides, carbon monoxide, hydrocarbons, fluorine, and chlorine compounds which, unlike nuclear power plant emissions, will continue to create acute environmental problems. The efficiency of electrostatic dust precipitators has increased from 90 to 99.8% during the last 10 years. Flue gas desulfurization, with an efficiency of 80%, entails specific investments in the range of 5-13 dollars/KWh, and an increase of 1 cent/kWh in the cost of electricity. Future research and development will focus on diffusion mechanisms, the effects of various pollutant concentrations, heat, and vapor on living organisms and on the atmosphere, waste heat utilization, fine dust separation techniques, fuel and flue gas desulfurization processes, wet and dry cooling towers, and possibilities to reduce radioactive emissions.

48048

Public Health Service, National Center for Air Pollution Control

POWELL COUNTY, MONTANA AIR POLLUTION ABATEMENT ACTIVITY. 81p., July 1967. 12 refs.

The air pollution problem in Powell County, Montana, emission sources, and control measures enacted are examined. The major emission sources in the area is a phosphate rock defluorination plant which emits particulates, hydrogen fluoride, and silicon tetrafluoride. Design, operation, and maintenance deficiencies of the plant are reviewed. To determine the severity of air pollution due to plant operations, topography, climatology, and fluoride distribution in grasses, foliage, water, and soil were examined. Data on temperature, precipitation, atmospheric stability, and wind speed and direction are included. Fluoride emission control activity is also reviewed.

48116

Crowley, D. P., M. P. Brash, B. W. Burrell, F. L. Tempesta, and F. Niehaus

TEST METHOD FOR THE ANALYSIS OF TOXIC PRODUCTS FROM BURNING MATERIALS -- PHENOLIC FOAM. Fire Technol., 8(3):228-236, Aug. 1972. 4 refs. (Presented at the National Fire Protection Association, Annual Meeting, 76th, Philadelphia, Pa., May 17, 1972.)

The toxic products given off by organic materials exposed to a large fire cannot be realistically assessed by conventional laboratory techniques such as pyrolizing small or powdered samples in an oven pyrolysis chamber and analyzing the gases given off, because the high surface temperatures and large internal temperature gradients that these materials experience when exposed to a fire are not properly simulated in such a chamber. Toxic products evolved from burning phenolic foam were determined in an experimental fire simulation facility. The experimental set-up, specimen preparation, and test procedure are described. Analysis of the gases by infrared spectrophotometry, gas chromatography, mass spectrometry, and colorimetry revealed that carbon monoxide, hydrogen fluoride, hydrogen chloride, hydrogen cyanide, and phenol were evolved in small amounts. A method of extending these results to actual field situations, based on mass loss rates of the foam measured in the fire simulation facility is presented.

48231

Dotreppe-Grisard, N.

PLASTICS AND THE ENVIRONMENT. DISPOSAL OF DOMESTIC REFUSE. (Matieres plastiques et environnement. L elimination des ordures menageres). Text in French. Tribune CEBEDEAU (Centre Belge Etude Doc. Eaux), 25(341):190-197, April 1972. 18 refs.

Problems of solid waste disposal and waste incineration-related air pollution are described with regard to Belgium. Air pollution, including odorous emissions, and corrosion are the basic problems of waste incineration. Some 2% of the domestic waste in Belgium consists of plastics, including 1.75% of polyethylene, 0.30% of polystyrene, and 0.20% of polyvinyl chloride (PVC). While PVC is the only plastic material to give rise to hydrochloric acid emissions, such emissions are generated by other components of the domestic waste, such as paper and wood. Since a considerable part of the HCl formed during incineration is adsorbed by alkaline buildups and fly ash, the gaseous HCl emission is much less than the theoretical amount liberated. The formation of HCl may be due to mineral chlorides and silicates forming highly volatile iron and aluminum chlorides, and to reactions of alkaline chlorides with acid sulfates. Incinerator waste gas analyses performed in the U.S.A. revealed the following pollutant concentrations: 1-330 ppm of HCl, 0.6-1.1 ppm of hydrofluoric acid, up to 106 ppm of sulfur dioxide, 57-138 ppm of nitrogen oxides, up to 45 ppm of carbon monoxide, 25-58 ppm of aldehydes, and other hydrocarbon contents below 10 ppm. The dust concentrations in the flue gases may range from 300 to 1000 mg/N cu m, and can be effectively reduced by electrostatic precipitators to as low a value as 120 mg/N cu m. Gaseous pollutants require scrubbers for their removal. Odorous components can be removed best by afterburning, while methods such as adsorption on graphite and masking by other compounds are prohibitively expensive or unacceptable. The best method, however, is to maintain the combustion chamber temperature above 750 C. Corrosion hazards in incinerators can be lessened by maintaining the gas temperature in a range of 900-1000 C, flow rates of 6-8 m/sec, applying secondary air, and by minimizing changes in the flow direction.

48429

Weisburd, Melvin I.

FERTILIZER INDUSTRY. In: Field Operations and Enforcement Manual for Air Pollution Control. Volume III: Inspection Procedures for Specific Industries. Pacific Environmental Services, Inc., Santa Monica, Calif., Office of Air Programs Contract CPA 70-122, Rept. APTD-1102, p. 7.14.1-7.14.17, Aug. 1972. 8 refs.

Two major sub-groupings of the chemical fertilizer industry are of particular importance as air pollutant sources and are considered in detail: the phosphatic compounds produced from phosphate rock, and ammonium nitrate produced by the reaction of ammonia with nitric acid. Processes, control methods, and inspection points are considered. Fluorine compounds are usually removed by scrubbers; particulate matter is removed by cyclones, cloth filters, and scrubbers; proper control and ventilation can reduce dust; baghouses and electrostatic precipitators can also be used to reduce pollutants.

48572

Schmitt, C. R.

THERMAL DEGRADATION CHARACTERISTICS OF VARIOUS POLYMERIC MATERIALS. J. Fire Flammability, vol. 3:303-315, Oct. 1972. 8 refs.

The toxic gaseous products evolved from the thermal degradation of various polymeric packaging materials were studied by mass spectrographic analyses. Vapors liberated from a flexible urethane foam at the temperature of melting and just prior to ignition contained toxic hydrogen cyanide gases; after ignition, the hydrogen cyanide content increased significantly. Analytical data were also compiled on the pyrolysis products of polyethylene, pigmented polystyrene, and fluorohalocarbon material. Thermal degradation products from the fluorohalocarbon at 250 C showed the presence of atomic mass units 20 and 36, indicative of hydrogen fluoride and hydrogen chloride, respectively. At 305 C, atomic mass units 47 and 66, corresponding to decomposition fragments Cl-C and C-Cl-F, respectively, were very prevalent. (Author abstract modified)

48849

Hettche, Hans Otto

AIR POLLUTION AND HEALTH - A PROGRAM OF 1960. (Luftreinhaltung und Gesundheit - ein Programm von 1960). Text in German. Staedtehygiene (Uelzen/Hamburg), 23(12):273-275, 1972.

The European Committee for Diagnostics of Health Damages (Eurotox) and for the Protection of the Population met in Paris in 1960 to investigate the air pollution problem. A resolution was passed calling for the improvement of domestic heating systems by promotion of central heating, for the reduction of toxic components in automobile exhausts, for the separation of industrial and residential areas by green belts, and for reducing the railroad emissions by turning to electric and diesel drives. Twelve years after this conference, it can be said that much has been done since 1960 for the reduction of air pollution. In the Ruhr area, the sulfur dioxide and dust emissions have been continuously monitored since 1964. The dust emission was reduced considerably, and the SO2 emission also went down markedly due to better electrostatic precipitators and the use of low-sulfur fuels. Gas and electricity are increasingly used for heat production. Oil central heating systems are being annually inspected in North Rhine Westphalia. The emission of hydrogen fluoride has received great attention; aluminum plants are now required to clean their waste gases satisfactorily. For decontamination of automobile exhausts, the lead concentration in gasolines is being reduced. The afterburning of carbon monoxide and hydrocarbons will become indispensable soon. Much has been done for electrification of the railroads.

48946

Ussar, Max Boris and Karl Bergmann

ENVIRONMENTAL PROBLEMS ON THE INDUSTRY. (Die Umweltprobleme der Industrie). Text in German. Berg-Huettenmaenn. Monatsh., 117(8):275-280, Aug. 1972. (Presented at the Oesterriche Bergbautag, Baden, Austria, April 25-28, 1972.)

General problems of industrial air pollution as encountered in industrialized countries are reviewed. The sulfur dioxide emissions show a downward trend in most industrialized countries, which is primarily attibutable to the increasing use of low-sulfur fuels. Dry and wet processes for the separation and conversion of SO2 in waste gases are expected to reach the stage of technological maturity before long. Nitrogen oxide emissions, determined by flame temperature and air excess, originate primarily in industrial and internal combustion engines processes. While industry generates practically no carbon monoxide due to near-complete combustion, automotive exhaust and domestic heating emit sizable proportions of this pollutant. A survey of the recent trends in the development of industrial and other emissions shows that coarse dust and SO2 as pollutants will be replaced, along with the associated problems, by such industrial pollutants as fluorine, chlorine, hydrocarbons, toxic and malodorous gases, vapors, and aerosols.

49617

Hata, Akio, Yutaka Kawano, Akio Yamaguchi, and Teruo Tanabe

AIR POLLUTION BY IRON AND STEEL PLANTS (TECHNICAL CONSIDERATION OF SOURCES). (Seitetsusho no taiki osen ni tsuite gijutsu men kara mita mondaiten (bo seitetsusho no gutairei yori)). Text in Japanese. Japan Society of Air Pollution, Proc. Symp. Japan Soc. Air Pollut., 13th, 1972, p. 161. (Nov. 7-9, Paper 116.)

Pollutants emitted by various types of furnaces of iron and steel works are discussed from the example of one plant. The dusts from the blast furnace generally contain 5-30 g/cu m dusts of iron oxide, sulfides and carbon. The emission concentration is 0.1 g/cu m and the total of more than 40 tons of dust are emitted monthly. At this plant, if the dust collectors are not operating for any reason, all of the dusts are discharged in the environment. From the blast furnace, 16.2% of the carbon monoxide content leaks into the atmosphere, and this is about 13 million cu m/mo CO. This is equivalent to exhaust emissions from 240,000 automobiles. A converter produces 10-15 kg/ton of dusts. Most dusts are ferrous oxide in the size of 0.3-1 micron. From three 60-ton furnaces, about 7 tons/mo of dusts are emitted. The soot leakage incidents are numerous, sometimes as often 184 incidents/mo. Six open hearth furnaces were operating until March 1971. The operation was discontinued, but after the dust collection, the emission concentration was as high as 0.5 g/cu m. Also, because of the addition of 300 kg fluoride per charge, 187 cu m/charge of hydrogen fluoride used to be created. One electric furnace of a 60-ton capacity produces 120-240 kg/ton/charge of dusts. The dusts contain chromium, nickel, manganese, molybdenum, and vanadium. The sintering pellet plant dusts contain a great quantity of sulfide and sulfur oxides. The amount of sulfur contained in the fuel at this plant is relatively low, but the total consumption is very large, and therefore, SOx emission is also large.

49738

Stoiber, Richard E., Daniel C. Leggett, Thomas F. Jenkins, Richard P. Murrmann, and William I. Rose

ORGANIC COMPOUNDS IN VOLCANIC GAS FROM SANTIAGUITO VOLCANO, GUATEMALA. Geol. Soc. Amer. Bull., vol. 82:2299-2302, Aug. 1971. 7 refs.

Gas samples collected at Sapper fumarole of the Santiaguito, Guatemala, volcano on Dec. 5, 1969, were analyzed by gas chromatography-mass spectrometry. The samples were composed of 95% air, presumably of atmospheric origin, water vapor, and both organic and inorganic gases. The total organic content was about 100 ppm, and the methane content was fairly high (14 ppm). The compounds identified in the gas samples were methane, xenon, nitrogen dioxide, ethylene, tetrafluoroethylene, ethane, carbonyl sulfide, hexafluoropropene, propene, propane, chlorodifluoromethane, chlorotrifluoroethylene, chloromethane, methanol, acetaldehyde, methanol, isobutene, butene, dichlorofluoromethane, ethanol, carbon disulfide, isopentene, propanol, acetone, trichlorofluoromethane, pentane, isopropanol, methyl acrolein, n-propanol, methylethyl ketone, hexenes, hexanes, benzene, cyclohexane, trichloroethylene, heptenes, methyl cyclohexane, toluene, octenes, octanes, 1,1,2-trichloro-1,2,2-trifluoroethane, hydrochloric acid, and hydrofluoric acid. The compounds are probably produced by heating of fossil soil or sedimentary layers by the magma.

49852

Kudrna, Jan

EXHALATION OF HARMFUL SUBSTANCES FROM BRICKWORK KILNS. (Exhalace skodlivin z cihlarskych pecl). Text in Czech. Stavivo, 50(3): 69-70, 1972. 3 refs.

Measurements of particulate emissions from brickwork kilns disclosed that they do not as a rule exceed prescribed norms, but excessive emission does occur in the case of old oil-fired kilns where the injection of oil into areas below 900 C or deficiency of air causes excessive soot formation. This defect can be removed by the injection of secondary air into the burners. Similar excessive emissions of soot by coal-fired kilns cannot be remedied. Hydrogen sulfide is rarely emitted as a pollutant; the real problem is sulfur dioxide. Measurements of SO2 emissions from 59 brickwork kilns were carried out in the German Democratic Republic. Maximal sulfur oxide concentrations were below 3 g/N cu m; the mean value of emissions from all kilns was 0.49 g/N cu m with an average stack height of 30-50 m. Sulfur trioxide is more harmful than SO2 and its noxious effect cannot be underrated because the bricks inside the kilns act as catalysts; consequently brickwork kilns emit a greater share of SO3 than other furnaces. The sulfuric acid formed is absorbed by the soot flakes. The share of SO3 of total sulfur oxides emission is on the average 25% but can reach 50%. Sulfur oxides can originate occasionally from brick clay; on the other hand, calcium carbonate dispersed in bricks in the course of firing combines with sulfur and prevents part of it from forming oxides. Many clays contain calcium fluoride, the mean content is 0.063%. In the firing 16% is emitted, 80% of the fluorine remains in the material. Fluorine emission fluctuates between 1 and 180 mg/N cu m with an average of 48 mg/N cu m. The sulfur oxides emission problem could be solved by using oil with a low sulfur content.

49886

Grjotheim, K., H. Kvande, K. Motzfeldt, and B. J. Welch

THE FORMATION AND COMPOSITION OF THE FLUORIDE EMISSIONS FROM ALUMINUM CELLS.

Preprint, Norwegian Society of Professional Engineers, Oslo, 44p., 1972. 42 refs. (Paper presented at the International Symposium on the Fluoride Problem in the Aluminum Industry, Trondheim, Norway, May 24-26, 1972.)

Data available on the fluoride consumption per ton of aluminum produced, the amount of fluorides retrieved from the anode gas, possible causes of the fluoride emissions, and possible reactions between the moisture content of the feed and the molten fluorides are surveyed. Quantitative calculation is presented for the emissions generated by vaporization from the melt, based on data for vapor pressures of sodium fluoride - aluminum fluoride melts. While vaporization is a significant source of fluoride emissions, other and equally important mechanisms must also contribute to the emission rates. The water introduced with the feed may in part lead to hydrolysis reactions in the fluoride melt, while it may also in part be reduced to hydrogen. Another source of hydrogen is the materials of the anode. Part of the hydrogen may be anodically oxidized to hydrogen fluoride which gives a significant contribution to the total fluoride emission rate. The reactions of water vapor with the fluoride- containing vapor from the melt, on the other hand, will alter the chemical composition of the emissions but will not contribute to the emission rate. The observed fluoride emission rates may be ascribed to three principal mechanisms, i.e., vaporization from the molten electrolyte, primary generation of hydrogen fluoride in the cell, and the entrainment of liquid droplets and solid dust. The available evidence indicates that these three mechanisms are of about equal significance.

49924

Teske, Wolfgang

AIR POLLUTION. PART I. Provincia de Buenos Aires (Argentina), Comision de Investigaciones Cientificas, Reunion Probl. Efluentes Ind. Contam. Ambiental, La Plata, Argentina, 1971, p. 1-18. (July 12-17.)

A general survey of the main problems developing because of air pollution is presented. The important emission sources discussed include industrial combustion and production processes in coking plants, the iron and steel industry, metal fabricating, copper melting plants, cement works, zinc production, sulfuric and nitric acid production, chemical plants, metallurgical production, mineral oil industries, viscose factories, power plants, domestic heating, and traffic with emissions from petrol and diesel engines. Emissions from each of these processes are reviewed, including aerosols, dusts, soot, carbon monoxide, sulfur dioxide, hydrocarbons, nitrogen oxides, fluorine compounds, hydrogen sulfide, carbon disulfide, and lead. Effects of these pollutants on the skin, eyes, lungs, respiratory system, heart, circulation system, liver, nerves, bones, stomach, and the intestinal system are listed. Harmful effects on plants, animals, and material objects are also considered.

50013

Kirsch H., K. Kautz, and R. Singh Dev

STUDY OF FINE DUSTS WITH AN ANALYTICAL ELECTRON MICROSCOPE. (Die Untersuchung von Feinstaeuben durch ein analytisches Elektronenmikroskop). Text in German. VGB Kraftwerkstechnik, 53(3):195-199, March 1973.

Dust samples from electrostatic precipitators of four incinerators burning industrial refuse were examined as to their concentration of fluorine compounds. An analytical electron microscope which combined the properties of electron microscope with those of an electron microprobe was used for the examinations. The electron beam passed a double condenser system and electromagnetic detectors. A mini lens behind the detector focused the electron beam on the sample producing an X-ray fluorescence radiation emitted in all directions. But only the radiation leaving at an angle of 45 deg was recorded by the non-dispersive detector and the two spectrometers. Each spectrometer had four analyzing crystals. The chemical and fine structure micro-analyses were carried out at 80 kV. In more than 20 individual samples from each incinerator, sodium fluoride was the most frequent fluorine compound. In the fly dust from incinerators for domestic refuse, calcium and lithium fluoride were most frequently identified.

50018

Sutter, Ernst

FLUORIDE MEASUREMENTS IN ALUMINUM PLANTS. (Fluoridmessungen in Aluminiumhuetten). Text in German. Staub, Reinhaltung Luft, 33(3):114-117, March 1973.

Fluorides were measured in Swiss aluminium smelting plants to assess the fluorosis hazard. Atmospheric conditions affected the efficiency of artificial ventilation. Ion selective electrodes were used to determine fluorides in personal samplers attached to workers. Measurements were taken during various seasons. The average values fluctuated between 0.2 and 1.5 mgF/cu m. No statistically proved dependence on the weather could be detected, but the wind around the furnace workshop did exert a considerable influence. By cutting out the influence of the wind on the ventilation system of the workshop, the fluoride concentration could be reduced. Adequate conduction of the air inflow into the electrolysis workshop is of great importance for a low fluoride concentration.

50242

Wolfson, M. R., M. S. Pakulak, C. E. Arthur, T. E. Doyel, and R. J. Morey

TOXICITY STUDY OF MK 50 MOD O ROCKET MOTOR EXHAUST. Naval Weapons Center, China Lake, Calif., Propulsion Development Dept., 14p., Aug. 1968. 4 refs. ORD Task 008-084-001/200-1/127-00-01, Rept. NWC-TP-4638. NTIS, DDC: AD 842118

A fluorocarbon base propellant, N-34, is used in the Mk 50 Mod O rocket. Toxic gases, hydrogen chloride, and hydrogen fluoride are exhausted during combustion. Exhaust clouds were sampled during rocket firings and to determine HCl and HF concentrations in the atmosphere in the vicinity of the launcher during firing. Topside HCl concentration was above the threshold limit value but below the tolerable limit for short duration exposures. Topside HF concentration at the launcher was above both the threshold and short duration limits; and 60 ft from the launcher, was above the threshold but below the tolerable limit for short exposures. Both the HCl and HF concentrations in the magazine were below their respective threshold limit values for extended and repeated exposures. (Author abstract modified)

50381

Rasch, Rudolf

EVERYTHING RETURNS TO DUST. (Alles wird wieder zu Staub). Text in German. Umwelt Duesseldorf, 3(1):49-53, 1973. 11 refs.

A comparison of all available solid waste disposal methods (sanitary landfill, composting, and incineration) shows that a controlled volume reduction within 1-2 hr is only feasible with incineration. With the sanitary landfill the decomposition processes are most difficult to control. It is granted that a

complete combustion is difficult to achieve in small incinerators. Therefore, they should not be allowed in residential areas. In large incinerators complete combustion is achieved by uniform charging, continuous operation, and high combustion chamber temperature. Analyses in the large incinerator in Duesseldorf revealed that the amount of volatile organic acids in the waste gases were on the lower detection limit. Of the 4,000,000 t/yr sulfur dioxide emitted in West Germany, 12,000 tons come from incinerators. The latter emit 5000 t/yr nitrogen oxides, 8000 t/yr hydrogen chloride, 50,000 t/yr hydrogen fluoride and 4,000,000 t/a dust. Nothing is known about the emission of heavy metals. An examination in power plants and incinerators has shown that toxic heavy metals such as lead, zinc, arsenic, and others are deposited in various sections of the heat exchanger which means that a considerable portion is not emitted into the environment with fly dust.

50938

Davids, P.

AIR POLLUTION THROUGH POLLUTANT EMISSION FROM INCINERATORS. (Die Luftbelastung durch die Schadstoffemission aus Muellverbrennungsanlagen). Text in German. Muell Abfall, 5(3):61-68, 1973. 17 refs. (Presented at the Muelltechnische Kolloquium, Stuttgart, West Germany, March 8, 1973.)

The incinerators in operation in the Federal Republic of Germany today are all similar in their design with the exception of individual components. For dust cleaning of the effluents, electrostatic precipitators are mostly used. A removal of gaseous pollutants is generally not pursued. In six incinerators a 1-week measurement program was launched to determine the type and quantity of the components of trash and their distribution in the gaseous and solid combustion residues which are important for air pollution. The dust measurements were taken behind the electrostatic precipitator to determine the dust composition in the cleaned gas. Main components were silicon aluminum, and iron compounds. The measured lead concentrations were below 1%, the zinc concentrations below 5.3%. In two samples none of these two components could be determined. Concentrations of chlorine, phosgene, hydrogen cyanide, hydrogen sulfide, and ammonia were about 1 mg/cu m (detection limit) or they were not detectable at all. For Cl2 and COCl2 this was also true in cases were 6% polyvinyl chloride had been added to the trash. Correlation of the measurement results yielded a significant relationship between hydrogen chloride and hydrogen fluoride emissions. Five hundred values for HCl and sulfur dioxide were available taken in one incinerator since 1966. For the period 1966 to 1972 a steady decline of the SO2 emission by about 1/3 was discernible. The HCl emission rose between 1967 and the beginning of 1970 by about 100%. Since then it remained constant.

50961

Gerhards, Kurt

SYNTHETIC WASTE IN TRASH AND ITS EMISSIONS FROM INCINERATORS. STUDIES AND DEVELOPMENT TRENDS. (Kunstoffabfaelle im Muell und ihre Emissionen aus Muellverbrennungsanlagen. Untersuchungen und Entwicklungstendenzen). Text in German. Muell Abfall, 5(3):68-71, 1973. 4 refs. (Presented at the Muelltechnische Kolloquium, Stuttgart, West Germany, March 8, 1973.)

In the year 1971 six 1-week measurement series were conducted with the aim of determining weight, type, and amount of synthetics in domestic refuse. Each resident throws away 4.1 kg of synthetic wastes/yr. A number of synthetics, primarily polyamides and polyurethanes, contain up to 19% nitrogen. Of the synthetic wastes in domestic refuse, polyamid contained 4.9%. Between 0.1 and 0.2 kg nitrogen/ton refuse are disposed of. The contribution of synthetics to the emission of nitrogen oxides is rather insignificant. None of the more important synthetics contain sulfur. The most important fluorine containing synthetic is polytetrafluorethylene, but its fraction among the synthetics is so small that no fluorine could be detected. Chlorine is an essential component of chlorinated polyethylene, polyvinylchloride, and polyvinylidenechloride. In domestic refuse from Bochum a chlorine fraction of 5.0% was found. The total chlorine fraction in the Bochum domestic refuse amounted to 3.45 kg/ton refuse, the fraction constituted by the synthetics alone 0.95 kg/ton refuse. Based on this data, the synthetic s share to hydrogen chloride emission for domestic refuse is 32%. Based on an estimated specific domestic refuse accumulation of 256 kg/resident/yr by 1980, an industrial refuse quantity of 116 kg/resident/yr, a bulky and communal refuse quantity of 34 kg/resident/yr synthetic quantity of 5.9%, the average chlorine emission will be 5.7 kg/ton waste. This is 50% more than in 1971.

51100

Davids, P.

AIR POLLUTION DUE TO THE EMISSION OF NOXIOUS SUBSTANCES FROM REFUSE INCINERATION PLANTS. (Die Luftbelastung durch die Schadstoff Emission aus Muellverbrennungsanlagen). Preprint, 1973. 38 refs. (Presented at the Refuse Meeting, 24th, Stuttgart, West Germany, March 8, 1973.) Translated from German, 36p.

The quantity and quality of emissions from refuse incineration plants are examined. Gaseous emissions include hydrocarbons, e.g., aldehydes and organic acids, chlorine and fluorine compounds, sulfur dioxide, nitrogen oxides, and carbon monoxide. The dusts contain various metal compounds, including silver, aluminum, boron, calcium, cadmium, chromium, copper, iron, potassium, magnesium, manganese, sodium, nickel, lead, silicon, tin, strontium, titanium, and zinc. Waste composition and controls to prevent emissions were examined.

51102

Gerhards, K.

PLASTIC SCRAP IN TRASH AND ITS EMISSIONS FROM TRASH INCINERATORS. INVESTIGATIONS AND TENDENCIES IN DEVELOPMENT. (Kunststoffabfaelle im Muell und ihre Emissionen aus Muellverbrennungsanlagen. Untersuchungen und Entwicklungstendenzen). Preprint, 1973. 4 refs. (Presented at the Refuse Meeting, 24th, Stuttgart, West Germany, March 8, 1973.) Translated from German, 14p.

The weight, type, and proportion of plastics in house trash are determined to study the contribution of plastics in refuse to emissions from incinerators. Based on 1971 data, plastics contents of trash and subsequent emissions are predicted for 1980. The major plastic components are polyolefins, polyvinylchlorides, and polystyrenes. Plastics combustion contribution to nitrogen oxide, sulfur, and fluorine compound emissions is negligible. The major pollutant related to plastics incineration is hydrogen chloride.

51137

Schulze, Ernst

THE GLASS CONTAINER INDUSTRY IN THE FUTURE: MARKETING, TECHNICAL ECONOMIC AND POLITICAL ASPECTS. (Die Hohlglasindustrie der Zukunft unter marktmaessigen, technischen und gesellschaftspolitischen Aspekten). Text in German. Glastech. Ber., 46(5):71-83, May 1973.

(Presented at the Glastechnischen Tagung, Wiesbaden, West Germany, July 5, 1972.)

The development of the container industry is considered, and market trends, structural changes in wares, packaging, production methods, and economics are discussed. Each industry has to cope with the problems of environmental pollution. The glass industry has eliminated, to a large extent, the fluorine components from its emissions. Further reductions of the emission were achieved through improved trough construction, reduced flow speeds, reduced use of fuels, and increased use of electricity, use of pelletted and granulated raw products, and addition of sodium lye for the maintenance of a residual moisture for transport. About 75% of the produced glass containers are no return bottles. They pose no problems with any of the waste disposal methods from the sanitary landfill and incineration to composting.

51282

Wood, R.

FLUORINE AS A POLLUTANT. 8. Trans. Brit. Ceram. Soc., 72(1):35- 37, Jan. 1973. 11 refs.

Fluorine as a contaminant in the environment, as well as the beneficial effects of this element to man, are described. Sources of fluorine contamination such as steelmaking, metal alloy production, brick, tile, and ceramic industries, aluminum production, phosphate fertilizer industry, phosphoric acid production, cement industry, and burning coal are discussed. A variety of other minor possible sources of airborne fluorine contaminants are described. A panel of the American Association for the Advancement of Science placed fluorine as the third in a list of five pollutants. Gaseous hydrofluoric acid and silicon tetrafluoride are the main fluorine compounds in polluted atmospheres which damage plants. Fluorosis in animal and humans is discussed. Legislation and standards in the United Kingdom are mentioned. The threshold limit values for hydrofluoric acid and inorganic fluoride are 2 and 2.5 milligram/cu m, respectively. A sampling procedure has been developed, based on the use of a membrane filter to collect particulate, and an alkali-impregnated paper to trap gaseous, fluoride.

52277

Gotsu, Isamu, Hiroshi Kagawa, Kunihiko Hasumi, Yasuo Abe, Toshimasa Maniwa, Kojiro Shimanuki, Masaaki Suzuki, Satoshi Itohara, Hiroyasu Watanabe, Kenji Anzai, Ichiro Iwahashi, Fumio Sato, Sobei Tanji, Ryoji Ochiai, Wasaburo Kawakami, Yokio Abe, and Takao Michiyama

INVESTIGATION OF LOCAL AIR POLLUTION IN CONCENTRATED AREA OF TILE MAKING INDUSTRY IN FUKUYAMA DISTRICT, KORIYAMA CITY. (Koriyama-shi Fukuyama chiku ni okeru kawara kojo chitai no taiki osen (SOx oyobi HF) chosa ni tsuite). Text in Japanese. Fukushima-ken Eisei Kenkyusho Kenkyu Hokoku (Fukushima Prefect. Inst. Public Health, Rept.), 20(4):91-98, Oct. 1972. 14 refs.

The efficiency of an exhaust gas treatment method in the tile making industry was investigated as well as the concentration of hydrogen fluoride in the atmosphere around tile making plants. Four plants were investigated. The rate of treatment efficiency of exhaust gas (sulfur oxides) from the tile making industries was 87% (A), 77.8% (F), 75% (C), 74.7% (D), and 69.4% (B). The rate of treatment efficiency for hydrogen fluoride was 96.2%, 91.3%, 90%, and 89.7% respectively. The average concentration of hydrogen fluoride in the atmosphere around the plants was determined to be 0.025 ppm (C and F), 0.005 ppm (D), and 0.00 ppm (E). Atmospheric hydrogen fluoride concentrations were measured continuously by automatic apparatuses for five days and nights. The average HF concentration in homes near the industries was 0.05 ppm near D, 0.04 ppm near A, 0.03 ppm near B, and 0.01 ppm near C.

52508

Schneider, Werner

CORROSION AND INJURIES FROM EMISSIONS CAUSED BY THE WASTE GASES OF INCINERATORS. (Korrosionen und Immissionsschaeden durch Muellrauchgase). Text in German. Energietechnik, 23(6):277-280, June 1973. 31 refs.

In the German Democratic Republic at present about five million tons of waste accumulate annually which are dumped. Since this amount will increase, incineration will gain increasing importance. Dusts and odors from incinerators can be satisfactorily treated. Great problems are still posed by gaseous pollutants and by corrosion. Since the waste gases from incinerators contain only about 0.03% of sulfur dioxide and the developing sulfur trioxide is bound by the high amount of fly dust (10 to 40 g/cu m), high temperature corrosion by alkali iron sulfate melts can be ruled out. Studies revealed that high-temperature corrosion in incinerators is mainly caused by hydrogen chloride in a reducing atmosphere. Low-temperature corrosion may be caused in incinerators by hygroscopic and easily melting zinc chloride and iron chloride hydrates. The emission of HCl at present amounts to between 0.5 and 1 g/cu m. The maximum allowable emission concentration for HCl is 0.015 or 0.05 mg/standard cu m. Efforts concerning the reduction of the emission of this pollutant are aimed at the replacement of polyvinyl chloride by other chlorine-free synthetics. The binding of HCl to calcium oxide or the removal by scavenging processes are also methods under consideration. Apart from this pollutant, the incineration waste gases also contain hydrogen fluoride in quantities up to 10 mg/cu m. This pollutant deserves special attention in future at the planning of new incinerators.

52664

Kanamaru, Go, Hirohisa Shima, Takaetsu Matsui, and Tamaki Hashizume

AN EXAMPLE OF ATMOSPHERIC POLLUTION BY FLUORIDES. (Hukkabutsu ni yoru taiki osen no ichirei ni tsuite). Text in Japanese. Mie-ken Kogai Senta Nenpo (Mie Prefect. Pub. Nuisance Center Annu. Rep.), no. 1:134-137, March 1973. 6 refs.

A ceramic plant emitted hydrogen fluoride gas which caused silkworms raised nearby to die, show poor growth, or stop preparing cocoons. Hydrogen fluoride from another ceramics plant in another city caused damage to cedars and pines. Hydrogen fluoride in these areas was collected on a filter paper, extracted with distilled water, and determined colorimetrically. Sulfur dioxide and phenol were simultaneously determined by the rosaniline- formalin method and 4-aminoantipyrin method, respectively. The highest HF value in the first city in 1970 was 78 micrograms/day/100 sq cm. After the detection of this high concentration, a jet scrubber replaced a water spray as the air treatment method. In the second city, the highest HF value was 58.3 micrograms/cu m; the highest SO2 concentration was 0.70 ppm; the highest phenol concentration was 0.156 ppm.

52741

Singh, R., K. Kautz, and H. Kirsch

THE PRESENCE OF TRACE ELEMENTS, PARTICULARLY OF FLUORINE IN ASH AND DUSTS OF INCINERATORS.

(Die Einbindung von Spurenelementen, insbesondere des Fluors, in Aschen und Staeuben von Muellverbrennungsanlagen). Text in German. VGB Kraftwerkstechnik, 53(6):408-414, June 1973. 9 refs.

Seven samples from domestic and communal refuse incinerators and eight samples from industrial incinerators were obtained. From each incinerator several ash samples from the combustion chamber and from the flue gas ducts through the boiler to the electrostatic precipitator were taken. The fluorine concentration in the ash samples was determined by water vapor distillation and subsequent determination of the formed hexafluoride (H2SiF6) silicic acid in the distillate by a specific electrode. The elements aluminum, barium, calcium, cobalt, chromium, copper, potassium, lithium, magnesium, manganese, molybdenum, sodium, nickel, lead, antimony, vanadium, and zinc, were determined by atomic absorption spectrophotometry. Phosphorus and iron were determined by photometry, silicion and sulfur by gravimetry, and chlorine by titration. The analyses indicated that both chlorine and fluorine enrich in depositions and the dust at a drop of the flue gas temperature to below 600 C. The fluorine enrichment is highest in the dusts from the electrostatic precipitator. This indicates that the hydrogen fluoride of the flue gas is bound to the dust particles. Of the fluorine compounds, most frequently calcium fluoride was found, whose low solubility is 0.16 g/l water at 20 C. The sodium fluoride was found only in samples from industrial incinerators. In the incinerators equipped with travelling grates, the binding of fluorine in the form of CaF2 is low because the ash remains in the combustion zone for a long time at high temperature. Most of the fluorine is bound in the electrostatic precipitator.

52912

Etterich, O.

ENVIRONMENTAL PROBLEMS OF MODERN HIGH-CAPACITY ARC FURNACES. (Umweltprobleme moderner Hochleistungs-Lichtbogenoefen). Text in German. Rade Rundschau (Austria), no. 3:556-557, 1973. (Presented at the Electric Steel Industry Conference, Zurich, Switzerland, Oct. 25-28, 1973.)

The decrease of environmental pollution by the steel industry despite the production increase by 16% between 1960 and 1971 is mainly due to the replacement of the Thomas process by electric melting and by the oxygen lancing process. With both processes, dust collectors reduce the dust emission to less than 150 mg/cu m waste gas. With the electric arc furnace a problem remains, that of the emission of carbon monoxide and fluorides. The CO can be removed by afterburning and the calcium fluoride can be replaced by other fluxing agents such as clay.

53295

Singh Dev, R., K. Kautz, and H. Kirsch

THE BINDING OF TRACE ELEMENTS, ESPECIALLY FLUORINE, BY ASHES AND DUSTS RESULTING FROM REFUSE INCINERATING PLANTS. (Die Einbindung von Spurenelementen, insbesondere des Fluors, in Aschen und Staeuben von Muellverbrennungsanlagen). Text in German. VGB Kraftwerkstechnik, 53(6):408-414, June 1973. 9 refs.

The incorporation of fluorine and other trace elements in the ashes and flue gases which result from the incineration of refuse is described. Analyses of samples of house and city refuse and of industrial sweepings are presented. Samples were obtained from various areas in the combustion chamber of the incinerators and from the flue pipes and were subjected to the following analyses: ashes were analyzed chemically for trace elements; all samples were subjected to a roentgenographic phase analysis; and samples with high fluorine content, usually fine particulate matter which filtered through the electrofilter, were analyzed by means of the electron microscope and with the aid of electron rays. The chemical analysis revealed that the ashes and other products of incineration differed considerably from the raw refuse and that the products of combustion interacted among themselves. Both chlorine and fluorine were found in sediments of dust when the temperature of the smoke was below 600 C. Fluorine was particularly concentrated in the particles in the electrofilter, most frequently occurring as calcium fluoride. Sodium fluoride was relatively rare, occurring only in industrial incinerator sediments.

53751

Daessler, H.-G., S. Boertitz and E. Auermann

STUDIES OF THE FLUORINE EMISSIONS FROM SOFT COAL-FIRED POWER PLANTS. (Untersuchungen ueber Fluor-Immissionen aus Braunkohlen-Kraftwerken). Text in German. Z. Ges. Hyg. Ihre Grenzebiete (Berlin), 19(8):568-570, 1973. 19 refs.

Because of reports of massive bee-kills in the vicinity of soft-coal operated power plants, the fluorine concentration in soft coal samples as well as in filter ash from these power plants was determined. From 10 strip mines in East Germany, 68 soft coal samples were taken according to geological aspects. After drying and grinding of the samples, the fluorine was separated by distillation and determined by colorimetry. The filter ash samples were distilled without ashing. In all examined soft coal samples, fluorine was found. The fluorine concentration was between 6 and 50 g/ton in East Elbe soft coal and between 2 and 178 g/ton in West-Elbe soft coal. At the combustion only part of the fluorine remains in the ash, the rest leaves in gaseous form. The filter ashes contained fluoride up to more than 400 ppm fluoride, chloride, and high quantities of sulfide.

53874

Tsunoda, Humio

AIR POLLUTION CONTROL BY FLUORIDES FROM PRIMARY ALUMINUM SMELTING. (Aruminyumu seiren kogyo ni okeru fukkabutsu ni yoru taikiosen boshitaisaku). Text in Japanese. Kogai to Taisaku (J. Pollution Control), 9(4):376-381, April 1973. 12 refs.

A prebake aluminum smelter gives easier air pollution control than the Soderberg automatic continuous burning anode system. The fluoride emitted from the electrolytic bath is removed by the double system of a bath-hood cleaner and chamber-ceiling cleaner. Hydrogen fluoride and tetrafluorosilicon are mostly emitted. Removal for the Soderberg and Prebake systems are 92-99% and 80-97% of the fluoride, respectively. A wind tunnel study was used to estimate the ground level concentration of gaseous fluoride dispersed by a line emission source. There is a close relationship between ground level and wind velocity and direction. The effects of fluorides on plants and animals and the composition of fluoride compounds emitted by aluminum smelters are reviewed.

53955

Pokhodnya, I. K., V. I. Shvachko, V. G. Ustinov, and S. A. Suprun

MASS-SPECTROMETRIC INVESTIGATION OF GASEOUS FLUORIDES FORMED DURING ARC-WELDING. (Mass-spektrometricheskoye issledovaniye gazoobraznykh ftoridov, dydelyayushchikhsya pri dugovoy svarke). Text in Russian. Avtomat. Svarka, 24(6):10-12, 1972. 9 refs.

Ion fragments of silicon tetrafluoride, SiF3+, SiF2+, HF+, and F+ ions were identified mass-spectrometrically in the mass spectrum of the gases formed during arc-welding by means of carbonate- fluorite type welding wires. Other mass-spectrometric investigations of titanium tetrafluoride and zirconium tetrafluoride revealed that the mass spectrum of TiF4 is composed of TiF2+, TiF3+ and TiF+ ions, and that of ZrF4 of ZrF4+, ZrF+ and ZrF3+ ions.

54622

Schneider, Werner

REFUSE INCINERATOR FLUE GAS-INFLICTED CORROSION AND EMISSION DAMAGES. (Korrosionen und Immissionsschaeden durch Muellrauchgase). Text in German. Energietechnik, 23(6):277-280, June 1973. 31 refs.

General problems of corrosion and plant (flora) damage due to refuse incinerator-generated flue gases are described. Corrosion occurring at temperatures above 400 C is due to a combination of hydrochloric acid as formed during the incineration of polyvinyl chloride and common salt with reducing atmosphere in overheater and steam generator zones of refuse incinerators. Quantitative volatilization of the iron chloride formed on metal surfaces above 400 C was observed. High-temperature corrosion can be avoided or reduced by feeding homogenized batches, the use of secondary air, and by limiting the steam temperature to 250-300 C. Corrosion at temperatures around 200 C is due to the formation of low-melting, hygroscopic hydrates of zonc and iron chlorides which predominantly precipitate in electrostatic dust separators. Watery condensates, containing HCl, sulfur dioxide, and sulfur trioxide, can cause low-temperature corrosion in small-capacity incinerators with wet type dust separation. Odorous emissions from incinerators can be avoided by the application of temperatures above 800 C, and combustion air intake from refuse bunkers. The SO2 emission concentrations from refuse incineration plants range from 0.5 to 1.0 g/N cu m. The HCl concentrations, being in the same range, are much more critical, and can easily cause plant damages around waste incineration plants. The HCl concentrations can be reduced by proper siting of the incinerators, and proper choice of the stack height. No phosgene is formed during waste incineration processes, while the hydrofluoric acid concentrations may reach up to 10 mg/N cu m.

55212

Burchard, John K.

SURVEY OF THE AIR POLLUTION PROBLEMS ARISING IN THE NON-FERROUS METALLURGICAL INDUSTRIES. Preprint, 10p., 1973. (Presented at the Seminar Control of Emissions from the Non-Ferrous Metallurgical Industries, Dubrovnik, Yugoslavia, Nov. 19-24, 1973.)

A survey of the air pollution problems arising in the non-ferrous metallurgical industries in 11 countries is summarized. The nonferrous metallurgical industry is a prime contributor to air pollution in all the countries. Sulfur oxides, particulates, fluorides, and hazardous metals are the main pollutants from the aluminum, zinc, copper, and lead industries. There are many significant differences which affect the capability of controlling smelter pollutants. Factors such as type of metallurgical process used, degree of use of existing control technology, age of facilities, ability of smelter to bear cost of control, physical layout of smelter, market for byproducts of control process, and many others have resulted in control efficiency in countries ranging from no control to over 90% control for some pollutants. Even within a single country, there are significant differences in control efficiencies from smelter to smelter. The primary SOx control technique is the contact sulfuric acid plant, although its use varies from country to country. All types of conventional equipment, precipitators, scrubbers, and bag filters are used for particulate control. Several countries report use of both wet and dry adsorption systems for control of fluorides from aluminum smelting. Sulfur oxide emissions from nonferrous smelting ranged from 1-13% of total country SOx emissions, ranking behind electric utilities in all cases. Particulates were a smaller percentage at 1-5%. Continuous research refforts in three areas are being conducted: problem identification, process modification, and gas cleaning equipment improvement.

55407

Grjotheim, K., H. Kvande, K. Motzfeldt, and B. J. Welch

THE FORMATION AND COMPOSITION OF THE FLUORIDE EMISSIONS FROM ALUMINUM CELLS. Can. Met. Quart., 11(4):585-599, 1972. 42 refs.

A survey of information in the literature regarding the total fluoride consumption per ton of aluminum produced in many plants and the amount of fluorides retrieved from the anode gas is presented, and a quantitative calculation is given for the fluoride emissions generated by vaporization from the melt based on data for vapor pressures of sodium fluoride-aluminum fluoride melts with relevant additions. The observed fluoride emission rates are ascribed to three principal mechanisms: vaporization from the molten electrolyte; primary generation of hydrogen fluoride in the cell; and the entrainment of liquid droplets and solid dust. Available evidence indicates that each mechanism is of about equal significance. Possible reactions between the moisture content of the feed and the molten fluorides include hydrolysis reactions in the fluoride melt and partial reduction to hydrogen as a result of introduction of water with the feed. Another source of hydrogen may be the materials of the anode. Part of the hydrogen may be anodically oxidized to hydrogen fluoride which significantly contributes to the total fluoride emission rate. The reactions of water vapor with the fluoride- containing melt vapor alter the chemical composition of the emissions but will not contribute to the emission rate. (Author abstract modified)

55601

Fumarola, Giuseppe and Rosanna Gardi

CURRENT TECHNICAL AND ECOLOGICAL PROBLEMS OF SECONDARY AIR POLLUTANTS. (Attuali problemi tecnici ed ecologici connessi con gli inquinamenti atmosferici secondari). Text in Italian. Inquinamento, 15(5):16-21, June 1973. 24 refs.

Sources of emission, abatement and control, and maximal permissible secondary pollutant emission levels in force in different countries are reviewed. Included are chlorine, fluorine, hydrochloric acid, hydrofluoric acid, and silicon tetrafluoride, pollutants created primarily localized pollution of relatively short duration. Damage caused to vegetation is primarily chlorosis or loss of chlorophyll; fluorine causes in domestic animals fluorosis or abnormal bone growth. The primary emis-

sion sources are chlorine and soda producing plants; hydrochloric acid producing plants; combustion of coal and oil; refuse incinerators; plants producing hydrofluoric acid, phosphoric acid, and phosphate fertilizers; and incinerators burning plastic refuse. Control includes dilution by high stacks, removal of chlorine and fluorine compounds from flue gases by absorption, adsorption, chemical reactions or condensation, or change of process. Most frequently employed is scrubbing with water in venturi towers and absorption by alkaline solutions. Maximal permissible concentrations in different countries differ widely which is not only a reflection of different technological control methods, but also of uncertainty about the toxic effects of the pollutants in question. Many standards are based on maximal allowable concentrations adopted by the American Conference of Governmental Industrial Hygienists.

55922

Zuendorf, Uwe

THE UMWELT PORTRAIT OF A CITY VI: DUESSELDORF. A COMBAT AGAINST THE WINGS OF A WINDMILL. (Umwelt-Staedteportraet (VI): Duesseldorf. Ein Kampf gegen Windmuehlenfluegel). Text in German. Umwelt (Duesseldorf), 3(5):39-45, 1973.

Duesseldorf is the least polluted city of the Rhine-Ruhr area. Forty percent of its air pollution stems from the 800 industrial complexes, and 40% comes from the 200,000 automobiles. Domestic heaters contribute only 20% to air pollution. Many domestic heaters in Duesseldorf are operated by electric current and natural gas. A large network supplied with remote heat further helps to keep air pollution by domestic heating low. Duesseldorf is included in the measurement program of North Rhine Westphalia. The dust fall is measured at 38 points of the city, the sulfur dioxide concentration is measured at one stationary measuring station, and on 156 further points random samples are taken. The high concentrations of fluorine compounds which exceed the recommended maximum allowable emission concentration of 5 microgram/cu m air causes considerable concern. In the district of Wersten, up to 14.8 microgram were measured. The fluorine concentration later dropped. The sources for the high fluorine emissions are still being sought.

56192

Hohmann, Ernst, Klaus Gottlieb, and Ursula Mueller

STUDIES OF MINERAL OIL AND MINERAL OIL PRODUCTS CONCERNING FLUORINE. RESULTS OF A JOINT TEST. (Untersuchungen von Mineraloel und Mineraloelprodukten hinsichtlich Fluor). Text in German. Erdoel Kohle (Hamburg), 26(11):647-649, Nov. 1973. 3 refs.

Six laboratories in West Germany agreed to employ the same test for determination of the fluorine concentration in crude oil. The crude oil was burned in an oxyhydrogen flame. The electrometric determination of the fluoride concentration in the condensate was carried out with a fluorine sensitive electrode. The detection limit of the method is 0.034 ppm F. The crude oils which were tested are listed in a table. These tests and the analysis of 42 further native crude oils representing more than 90% of the crude oil processed in West Germany yielded that if there is any fluorine present its concentration is lower than the detection limit. Therefore extra light and heavy fuel oil which is produced by simple distillation from the analyzed crude oils provide no source for the emission of fluorine.

57231

Schultz, Hyman, E. A. Hattman, and W. B. Booher

THE FATE OF SOME TRACE ELEMENTS DURING COAL PRETREATMENT AND COMBUSTION. Am. Chem. Soc., Div. Fuel Chem., Preprints, 18(4):108-113, 1973. (Presented at the American Chemical Society, National Meeting, 166th, Chicago, Ill., Aug. 26-31, 1973.)

In one study, selected coals were crushed and separated in organic fluids of known specific gravity. The starting coal and each specific gravity fraction were analyzed for the trace elements mercury, copper, chromium, manganese, nickel, and fluorine. In the second study, coal was combusted in a 100 g/hr combustor, and the ash and flue gases were collected and analyzed for mercury, cadmium, and lead. Then coal and ash were obtained from a 500 lbs/hr furnace and from commercial power plants. Analytical methods and results are described. As much as 40% of the mercury in the coal was associated with the high specific gravity fraction of the coal. Thus, if the pyrite is removed from coal to lower sulfur emissions, a substantial part of the mercury is also removed at no extra cost. About 10-15% of the mercury from the coal may remain in the fly ash in coal-burning power plants. Taking both factors into consideration could reduce the maximum emission of mercury to about 50% of that present in the coal. Cadmium and lead are less volatile than mercury, and thus they are retained in the fly ash to a greater extent than Hg. It is expected that even less volatile elements would be retained in the fly ash to an even greater extent than Pb and Cd. Determinations of fluorine, copper, manganese, chromium, and nickel were only preliminary and emphasized the difficulties inherent in trace analyses of matrices as complex as coal. Trace analysis require extreme vigilance. Coal handling procedures themselves may add trace elements to the coal. (Author summary modified)

58334

Gotsu, Isamu, Hiroshi Kagawa, and Kojiro Shimanuki

INVESTIGATION OF LOCAL AIR POLLUTION IN CONCENTRATED AREA OF TILE MAKING INDUSTRY IN FUKUYAMA DISTRICT, KORIYAMA CITY. (Koriyama-shi, Fukuyama chiku ni okeru kawara kojo chitai no taiki osen (SOx oyobi HF) chosa ni tsuite). Text in Japanese. Taiki Osen Kenkyu (J. Japan. Soc. Air Pollution), 8(3):498, Oct. 1973. (Presented at the Japan. Society of Air Pollution, Annual Meeting, 14th, Fukushima, Japan, Nov. 6-8, 1973, Paper 228.)

In 1970, unknown causes damaged the rice plants in the vicinity of tile factories in Koriyama. Similar damage in other areas suggested damages by hydrogen fluoride in the stack gas, and in August 1971, stack gas content was measured; 150 ppm of sulfur oxides and 20 ppm of hydrogen fluoride were detected. Seven of 14 tile plants installed stack gas treatment systems under the guidance of Koriyama city, and the systems began operation in January 1972. In April, stack gases were analyzed by the arsenazo III method and spectrophotometry; SOx concentration at the flue exit was 31-40 ppm and showed about 69.4-87% elimination rate; HF measurements were 12-17 ppm and elimination ranged between 98.7 and 96.2%. The SOx maximum was 3.68 ppm and was rather low, but the HF figures were relatively high compared with the figures of similar plants in other prefectures. The daily 8-hour average of environmental HF in the vicinity was 0.02-0.03 ppm and was higher than that of the entire prefecture. The causes may be the low smoke stack, low temperature of the stack gas, and the hilly topography, and poor dispersion. Also, combined pollution with the stack gases from the nearby brick and ceramic factories is suspected.

58370

Fujiyoshi, Kaichi, Takashi Niwa, Masakatsu Kajikawa, and Tomokuni Hayakawa

FLUORIDE EXHAUSTED FROM SEVEN TYPES OF CERAMIC INDUSTRY. (Tojiki kankei kojo no gyoshu betsu ni yoru fusso kagobutsu no haishutsu ni tsuite). Text in Japanese. Taiki Osen Kenkyu (J. Japan. Soc. Air Pollution), 8(3):360, 1973. (Presented at the Japan. Society of Air Pollution, Annual, Meeting, 14th, Fukushima, Japan, Nov. 6-8, 1973, Paper 104.)

Emission gases from ceramic factors were investigated by seven classifications of refractory bricks, mosaic tiles, exterior tiles, interior tiles, dishes, glazed roof tiles, and unglazed roof tiles. The JIS method of measurement and analysis wery used. The hydrogen fluoride emission from refractory brick kilns were especially high, at 48 ppm. Mosaic tile plants emitted less than 5 ppm of HF. All tiles using glaze (exterior, interior, dishes, glazed tiles) emitted relatively high concentrations of HF (around 10 ppm). The causes were probably the chemical agents used for lowering the melting point. Unglazed tiles are baked in a single- process kiln, and the temperature seemed to affect HF emissions very much. At one kiln, when the kiln top temperature was 500- 600 C, HF emisison began to increase from 0.66 order to 6.4 ppm order, and reached the highest concentration of 110-320 ppm at 800-900 C. However, at another kiln of the similar type, HF began to decrease at 600 C, and at 800 C, 85% of the total emission was diminished.

58402

Kawasaki, Gunji, Masao Yamasaki, Yasutaka Hosono, Hisao Arakawa, Sachio Yamoto, and Masami Imai

ON FLUORIDES IN EXHAUST GAS (1). (Fusso kagobutsu hasseigen chosa ni tsuite - sono 1 - chitsugyo kankei kojo hasseigen chosa). Taiki Osen Kenkyu (J. Japan. Soc. Air Pollution), 8(3):361, 1973. (Presented at the Japan. Society Air Pollution, Annual Meeting, 14th, Fukushima, Japan, Nov. 6-8, 1973, Paper 105.)

The emission gases from nine ceramic plants producing tiles and bricks in Toyama prefecture were analyzed. Much fluoride, hydrogen chloride, and other chlorine gases were found in the flue gas from the bittern additive, glaze, and the tile materials. Fluoride emissions ranged from 9 to 174 mg/N cu m, and Cl gas from 7 to 516 ppm. At one of the plants, an elimination system was installed for flue gas, and the F content in the flue gas decreased from 131 to 0-1.1 mg, Cl gas from 90 to zero. The environmental concentration of F at 70 m from the plant reduced from 320-410 micrograms F/1000 sq m/month to 0.32, and at 200 m, from 45-56 micrograms to 0-32. Fluorides and HCl gas began to form at 600 C, and reached peaks at 900 for HCl and at 950 C for F.

58939

Baribault, R. P.

PRESENT PROBLEMS IN ALUMINUM MELTING PLANTS. (Aktuelle Probleme der Aluminium-Schmelzhuetten). Text in German. Metall, 27(12): 1228-1231, 1973. (Presented at the Organization of European Aluminum Melting Plants, Annual Meeting, Munich, Sept. 21, 1973.)

The quantity of coated aluminum products for canning and food wrapping purposes such as weather resistant coatings in the construction industry, and coating of kitchen apparatuses of trailers has more than quadrupled between 1962 and 1972 in the U. S. In Europe the increase was even higher. It rose from 57,000 tons in 1970 to 71,000 tons in 1971 to 100,000 tons in 1972. Two types of coated aluminum are of special importance to air pollution, because of fluoride and chloride pollution. Although their fraction is presently still low (about 1%) it is expected to increase. Presently the air pollution problem can be solved with wet collectors. Because of the corroding effect of the waste gases, the construction and material of the scrubber must be carefully selected. All waste water must be cleaned. A closed cycle would be the best solution, but presently no satisfactory method is yet in operation. Another problem is the high magnesium concentration of the alloys used for the manufacture of cans. A comparison of the capital investment costs for a new secondary coated aluminum melting plant with 20,000 tons annual production with and without facilities for cleaning the waste gases shows that $3 million are required for a plant with air pollutant cleaning devices and roughly $2.4 million without such devices.

59257

Magee, E. M., H. J. Hall, and G. M. Varga, Jr.

POTENTIAL POLLUTANTS IN FOSSIL FUELS. (FINAL REPORT). Esso Research and Engineering Co., Linden, N. J., U. S. Environmental Protection Agency Contract 68-02-0629, Program Element 1A2013, EPA-R2-73-249, GRU. 2DJ.73., 300p., June 1973. 110 refs.

Data obtained from the literature on sulfur, nitrogen, and other potential pollutants in fossil fuels in the United States are presented. The data are categorized according to the location of the raw fuels, and are analyzed for geographic effects on composition. Good data and useful correlations with source locations are available for petroleum sulfur, nitrogen, and nickel/vanadium, but not for other potential pollutants. A large amount of data is presented for trace elements in coal and nearly complete data are available for sulfur. Additional data include: spectrochemical analyses of coal ash for trace elements, rare elements in coal, mercury in coal, determination of arsenic in coal, colorimetric determination of beryllium, chemical analysis for germanium and gallium in head samples of fly ash and flue dust, spectrochemical analysis of coal ash, and method for determination of fluorine in coal.

59494

AIR POLLUTION AND ITS SOURCES. (Die Luftverunreinigung und ihre Quellen). Text in German. Bull. Eidgenoess. Gesundheitsamtes, Beilage B, no. 6:311-318, Dec. 1973.

The sources of air pollution in Switzerland are surveyed. In Switzerland, regional and local air pollution is due to domestic heating and traffic, as well as to industry and trade. Domestic heating, for which fuel oil is mainly used, is responsible for sulfur dioxide and soot emissions. The SO2 levels measured in urban areas in winter are 5 to 10 times larger than those measured in summer. Unless adequate measures are taken, the domestic heating-generated air pollution will increase parallel to fuel consumption. Exhaust gases and gasoline vapors constitute the basic pollutants generated by automobiles. While evaporation losses have been minimized by positive crankcase ventilation, exhaust emissions, containing such pollutants as carbon monoxide, nitrogen oxides, unburned hydrocarbons, and lead compounds, continue to be a problem. Industrial firing equipment generates less soot but more SO2 than domestic heating equipment. Various gases, vapors, dusts, smoke, soot, and fluorides are the major specific industrial emissions. The respective shares of domestic heating, industries, and traffic in the generation of waste gases in Switzerland are 50%, 19%, and 23.5%.

59775

Ministry of Labor, Health, and Welfare of North Rhine-Westphalia (West Germany)

IRON AND MALLEABLE-IRON FOUNDRIES. (Eisen- und Tempergiessereien). Text in German. In: Reine Luft fuer morgen. Utopie oder Wirklichkeit? Ein Konzept fuer das Nordrhein-Westfalen bis 1980. p. 38-40, 1972.

The state of the art and the expected evolution until 1980 of the dust, sulfur dioxide, and gaseous fluoride emissions from iron and malleable-iron foundries in North Rhine-Westphalia are outlined. By reducing the specific dust emission from melting furnaces from 1.5 kg to 1.0 kg/ton of Fe, and by the introduction of total dust separation, covering the entire melting process, the yearly dust emission is expected to decline from 8400 tons to 5000 tons. The SO2 emission, now 4800 tons/yr at a specific emission of 1.6 kg/ton of Fe, is expected to decline by 33% due to the reduction in the coke consumption, and to the anticipated increase in the use of natural gas, and electric melting furnaces. The gaseous F emission from basic and non-basic furnaces, 100 tons in 1969, is expected to fall to 10 tons in 1980 due to the abandonment of furnaces with basic linings.

59921

Goodyear Atomic Corp.

ENVIRONMENTAL EFFECTS OF THE CONSTRUCTION AND OPERATION OF A GASEOUS DIFFUSION PLANT. (FINAL REPORT). Atomic Energy Commission, 33p., July 26, 1973. 8 refs. NTIS: ORO-725

A study was performed to assess the environmental effects of the construction and operation of a gaseous diffusion plant for separation of uranium isotopes. Radioactive contamination, both alpha and beta-gamma, was judged possible only as a result of accidental release or from cleaning of equipment that is removed from the cascade. Alpha radioactivity in air samples from four locations averaged from 0.4-0.5 times 10 to the minus 13 micro Ci/ml, while beta-gamma averaged from 4.0-4.4 times 10 to the minus 13 micro Ci/ml. Small quantities of hydrogen fluoride were present in both the hydrogen and fluorine streams; average concentrations of fluorine found in the ambient environment at the plant examined were less than 1 ppb. Average sulfur dioxide air samples taken at four locations ranged from 28-42 micrograms/cu M, while particulate matter emissions were about 0.17 lb/million Btu input. Emission rates for SO2 were slightly under 6 lbs/million Btu input and were in excess of the state (Ohio) standards. The use of lower than 3% sulfur fuel is expected to correct the situation.

60281

Mitra, S. K.

SOURCES CHARACTERISTICS OF LIQUID AND GASEOUS EFFLUENTS FROM FERTILISER PLANT. Indian J. Environ. Health, 15(4):322-328, Oct. 1973.

Air pollutants, liquid effluents, and solid wastes generated from operations in the fertilizer industry are reviewed in terms of their sources; physical and human health effects, and possible control measures. Air pollutants considered include: fall out particulates, suspended particulates, hydrocarbons, oxides of nitrogen, carbon monoxide, sulfur oxides, hydrogen sulfide, and hydrogen fluoride. Appropriate control strategies outlined include: the use of collectors, vapor recovery systems, by-product recovery, combustion techniques, and stack gas scrubbing. Effects range from soiling of property and visibility reduction for particulates to plant damage and adverse human health effects for oxides of nitrogen.

60283

Raman, V., P. K. Yennawar, S. K. Maira, N. S. Manthapurwar, and G. Ramkumar

AIR POLLUTION ASPECTS FROM FERTILISER MANUFACTURE. Indian J. Environ. Health, 15(4):283-288, Oct. 1973.

A review of the common pollutants generated by fertilizer manufacturing and their sources of emission is presented along with some emission data collected from field studies. Pollutants considered are: sulfur dioxide generated from sulfuric acid manufacture, steam generation, and process heaters and furnaces; nitrogen oxides generated from nitric acid production and acidulation (nitrophosphate); dusts generated from grinding and transport of raw materials, raw material storage, escape from drier outlet points, and prilling towers; ammonia generated from its synthesis by reacting hydrogen and nitrogen and in urea production; fluorides generated from phosphoric acid plants and complex fertilizer plants; and sulfur trioxide and acid mists generated from the manufacture of sulfuric acid. Results are presente/ from source sampling during a field visit to a fertilizer plant.

60421

Hishida, Kazuo

TREATMENT TECHNIQUES FOR AIR POLLUTION-RELATED HARMFUL SUBSTANCES. (Taiki osen kankei yugai busshitsu shori gijutsu). Text in Japanese. PPM (Japan), 5(5):68-93, May 1974.

Chemical and physical information on the formation of pollutants, control methods, and maintenance and inspection of control equipment are reviewed. Cadmium and its compounds, chlorine and hydrogen chloride, fluoride and hydrogen fluoride, and lead and its compounds are described. Various industries and processes creating these substances are: Cd refining; Cd paint drying processes; various soda industries; manufacvturing of chlorine, polyvinyl chloride, ferrous chloride, activiated carbon, bleach, and chloroform; aluminum refining electric furnaces; and manufacturing of glass, phosphoric acid, calcium superphosphate, phosphate fertilizers, hydrogen fluoride, frosted glass and opaque glass; refining of lead, copper, and zinc; secondary refining of lead; manufacturing of lead paint, glass, nitrogen oxides; ammonia oxidation, and combustion. The forms, properties, toxicity of these substances, and the symptoms of health damages ard described.

60727

Ministry of Labor, Health, and Welfare of North Rhine-Westphalia (West Germany)

WASTE INCINERATION. (Muellverbrennung). Text in German. In: Reine Luft fuer morgen. Utopie oder Wirklichkeit? Ein Konzept fuer das Nordrhein-Westfalen bis 1980. p. 55-60, 1972.

The state of the art and the expected evolution of the dust, sulfur dioxide, hydrochloric acid, and fluorine emissions from municipal waste incinerator plants in North Rhine-Westphalia are outlined. Dust emissions are expected to play a minor role in the total incinerator-generated emission in 1980 since the total dust emission presently amounts to some 500 tons/yr, and all waste incinerator plants are equipped with dust separators with a minimum efficiency of 95%. The emission of organic compounds can be effectively controlled by optimized combustion conditions. The PVC (polyvinyl chloride) content of domestic refuse, now well under 1%, expected to increase four-fold by 1980, would result in an enormous increase in the HCl emissions because fly ash and slag have reduced adsorption ability for HCl. The HCl emissions can be controlled by

wet scrubbing processes, while dry adsorption is both inefficient and costly. The SO2 emission would also increase rapidly. Slowdown of the increase in the SO2, HCl, and F emissions is expected from the use of flue gas cleaning devices with a minimum efficiency of 80% for new plants from 1976 on. The introduction of such flue gas cleaning devices also for existing incinerators in 5 more years will result in a net decrease in the pollutant emissions.

60728

Ministry of Labor, Health, and Welfare of North Rhine-Westphalia (West Germany)

NONFERROUS METALLURGY. (NE-Metallerzeugung). Text in German. In: Reine Luft fuer morgen. Utopie oder Wirklichkeit? Ein Konzept fuer das Nordrhein-Westfalen bis 1980. p. 60-65, 1972.

State of the art and the expected evolution of the pollutant emissions from nonferrous metallurgical plants in North Rhine- Westphalia are outlined. Aluminum works cause local air pollution by the emission of gaseous fluorine, dust (alumina and fluorides), sulfur dioxide, and carbon monoxide. The specific fluorine, dust, and SO2 emissions are 1.5-0.8 kg/ton, 20-9 kg/ton, and 15-3 kg/ton, respectively. Aluminum re-melting plants emit chloride aerosols, metal oxides, gaseous fluorine, and dust. The particulate emission is expected to fall from 1320 tons to 680 tons yearly in 1980, while the re-melting capacity will double. Lead melting plants emit mostly SO2 and dusts containing zinc, cadmium, arsenic, bismuth, copper, and tin. The Pb and Zn emission will be drastically reduced by 1975. The Pb, Zn, and Cu emissions from Cu melting plants, already below 50 mg/cu m, are not expected to decline further, while the hydrochloric acid emission will be reduced by 50% by 1980. The SO2 emission will increase from 900 tons in 1970 to 1100 tons in 1980. The SO2 emission from Zn smelting plants will rise considerably until 1975, and further reduction in the SO2 emission is expected from the introduction of the double-contact sulfuric acid production process and from flue gas desulfurization. The maximum allowable concentration of dusts containing toxic components in nonferrous metallurgical plants will be reduced from 150 mg/cu m to 50 mg/cu m.

60729

Ministry of Labor, Health, and Welfare of North Rhine-Westphalia (West Germany)

STONE AND EARTH INDUSTRY. (Stein und Erden). Text in German. In: Reine Luft fuer morgen. Utopie oder Wirklichkeit? Ein Konzept fuer das Nordhein-Westfalen bis 1980. p. 65-66, 1972.

The state of the art and the expected evolution of emission in the stone and earth industry in North Rhine-Westphalia, as well as measures to be taken for pollution abatment in these industries are outlined. Dust, fluorine compounds, lead, zinc, barium, selenium, cadmium, boron, strontium and hexavaleent chromium compounds, as well as combustion process-generated sulfur dioxide are the chief pollutants in the stone and earth industry. While measures taken a few years ago have resulted in a decrease in the dust emissions in cement works, the results achieved cannot be regarded as satisfactory. Step-up of cement production, and the trend toward larger production units will most probably result in a disproportionately great increase in the dust emissions due to labile operating conditions. Permanent control of the efficiency of dust-separating equipment, and automatic shutdown of clinker mills during periods of high emission rates in the cement industry, as well as the use of adequate apparatuses for the separation of F2, Zn, Pb, and other volatile toxic compounds in the brick and glass industries, will be required for emission abatement.

60827

Trefois, M. A.

METALLURGY AS A POLLUTING INDUSTRY. (La Siderurgie en tant qu industrie polluante). Text in French. Rev. Serv. Publ., 32(1):3-7, 9-16, 1970. 2 refs.

Problems of air pollution and techniques and equipment available for its abatement in metallurgy are surveyed. Sulfur dioxide, arsine, nitrogen oxides, fluorine and chlorine compounds, ozone, carbon monoxide, hydrocarbons, dust, aerosols, and smoke are the principal pollutants emitted by metallurgical plants. Dust chambers, settling chambers, cyclones, multicyclones, scrubbers, venturi scrubbers, and electrostatic precipitators are among the principal dust emission control equipment used in metallurgical plants. The dispersion of the pollutants can be essentially improved by high stacks. Modern metallurgical plants designed with respect to air pollution control include such emission control equipment as Pratt-Daniel dust separators for coke charging and for agglomerate transport equipment, wet methods of coke quenching, Multivortex dust separators for agglomeration lines, Centicell dust separators for agglomerate discharge, cyclone groups for coke handling at the blast-furnaces, and bag filters for the steel melting furnace.

60866

Ministry of Labor, Health, and Welfare of North Rhine-Westphalia (West Germany)

IRON AND STEEL INDUSTRY. (Eisen und Stahl). Text in German. In: Reine Luft fuer morgen. Utopie oder Wirklichkeit? Ein Konzept fuer das Nordrhein-Westfalen bis 1980. p. 32-37, 1972.

State of the art and the expected evolution of the particulate, sulfur dioxide, fluoride, and metal oxide emissions from the different processes in the iron and steel industry in North Rhine-Westphalia are outlined. While the electric-arc furnace process, and especially the oxygen converter process, will acquire increased shares in total steel output, the share of the open- hearth furnace process will decrease, and Thomas steel will fade out completely by 1980. Ore dressing operations are responsible for considerable emissions of sulfur dioxide, fluorides, chlorides, and dusts containing lead, manganese, copper, antimony, and other metals. Blast-furnaces are responsible for dust, carbon monoxide, nitrogen oxides, sulfur dioxide, and hydrogen sulfide emissions. Dust separation at oxygen converters is done primarily by means of wet type dust separators and electrostatic precipitators. The dust concentration in the cleaned waste gases from tissue filters and electrostatic precipitators should be limited to 30-40 mg/N cu m and to 50 mg/N cu m, respectively. The considerable CO emissions could be modestly decreased by limiting the air-excess coefficient to 0.1. Electric-arc furnaces should be equipped with suction hoods and tissue filters. Also, fluorine-containing fluxes should be abandoned. The emissions from iron and steel works can be abated by the shutdown of obsolete works, by the use of improved techniques of gas collection and purification for new plants, by the combined removal of sulfur and F2 from agglomeration plant-generated waste gases, and by the introduction of total dedusting for steel works, including electric-arc furnaces. The maximum allowable dust concentrations should be determined as a function of their content of toxic components.

61007

Brocke, W.

AIR POLLUTION BY EMISSIONS FRO'.. CONVENTIONAL POWER PLANTS. (Die Luftbelastung durch Emissionen konventionneler Kraftwerke). Preprint, Society of German Radiation Protection Physicians and Society for Radiation and Environmental Research, 1971. 9 refs. (Presented at the Society of German Radiation Protection Physicians/Society for Radiation and Environmental Research Joint Meeting, 12th, Environmental Protection in Nuclear and Conventional Power Production, Oct. 8-9, 1971.) Translated from German, 13p.

Conventional power plants produce dusts, sulfur oxides, fluorine compounds, nitrogen oxides, carbon monoxide, and gaseous hydrocarbons. These emissions in the Federal Republic of Germany are estimated for 1970, 1975, and 1980 for bituminous coal, lignite, heating oil, and gas. From 1970 to 1980, particles are expected to increase by 13%, SOx by 22%, F compounds by 18%, NOx by 34%, CO by 35%, and HC by 13%. Emissions of sulfur dioxide from stationary sources in power plants, industrial plants, and home heating make up 88% of the total emission of SO2 in the German Federal Republic. Power plants will produce 41%, 40%, and 36% of the total SO2 emissions in 1970, 1975, and 1980, respectively. Power plants will produce 70% and 83% of the F emissions in 1970 and 1980, respectively. Power plants in Germany produce 18 to 23% of the NOx emissions. Half of all particle emissions come from stationary emissions, and 18% came from power plants in 1970. This will rise to 26% by 1980. Different fuels and operating conditions can cause different amounts of emissions. Operating and emission data are given for a 600 MW power plant run on bituminous coal, lignite, heating oil, and gas.

61154

Kremer, Hans

EMISSION FROM FIRING SYSTEMS. (Emission von Feuerungen). Text in German. Umwelt Aktuel., no. 4:29-44, 1973. 38 refs. (Presented at the Congress Umwelt 72, Stuttgart, Germany, June 30-July 9, 1972.)

The particulate and gaseous emissions from firing systems and their causes are reviewed. In the Federal Republic of Germany annually 1 million tons of particulates, 3 million tons of sulfur dioxide, 600,000 tons of carbon monoxide, 600,000 tons of nitrogen oxides, 130,000 tons of hydrocarbons, and about 10 tons of fluorine compounds are emitted by firing systems. Sulfur control measures include the removal of pyrite from coal and the hydration of heavy oil. The costs of these measures are estimated. Dusts can be satisfactorily removed in dust collectors. Nitrogen oxides can be reduced by near stoichiometric combustion, two- or more stage combustion, waste gas recirculation, and water injection.

61183

Schmidt, E.

BALANCE OF AIR POLLUTING FLUORINE FRACTIONS. (Bilanz luftverunreinigender Fluoranteile). Text in German. Bundesverband der Deut. Ziegelind. Forsch., vol. 80:21-24, 1973.

On a brick kiln with a capacity of 3800 kg/hr and a fuel consumption of about 152 kg/hr, measurements of the sulfur dioxide and trioxide and of the fluorine emission were taken. The gas was sampled with a heated quartz tube which was followed by a filter filled with quartz wool for separation of those fractions bound to dust. For analysis of the fluorine concentration, the gas sample was led through a scrubber filled with 2n caustic soda. The samples thus obtained were filled into synthetic bottles for later analysis in the laboratory. The fluorine was determined by water vapor distillation and following colorimetry by the Belcher-West method. The emission of SO2 and SO3 was determined separately in an apparatus by Corbett where SO3 is first absorbed in isopropanol and SO2 next in iodine solution. The concentrations were determined by simple titration. The main measurements were taken over a period of 8 days. They were followed by measurements over 1 day after the furnace operation had been halted. The average concentration of the fluorine emission was 138 mg/cu m. The highest concentration measured was 201 mg F/cu m, the lowest 75 mg/cu m. The sum of SO2 plus SO3 was 328 mg/cu m, with SO3 constituting 71%. On the average, 59% of the fluorine entered with the crude material were driven off. The values fluctuated in dependence of the kiln operation.

61564

Nakagawa, Yoshihiro, Isho Mitsuki, and Takei Takada

ATMOSPHERIC POLLUTION BY FLUORINE COMPOUNDS IN A DISTRICT AROUND A CERTAIN IRON MAKING FACTORY. (Bo-seitetsu kojo shuhen chiku ni okeru fusso kagobutsu ni yoru taiki osen). Text in Japanese. Hyogo-ken Kogai Kenkyusho Hokoku (Rep. Environ. Sci. Inst., Hyogo Prefect.), no. 5:47-51, Dec. 1973. 6 refs.

Although it is not known popularly, steel making factories usually discharge considerable amounts of fluorine compounds as silicon tetrafluoride or hydrogen fluoride because the factories use calcium fluoride as an extension or slag forming agent. The atmospheric pollution in the neighborhood of a steel plant was examined through the analysis of water soluble hydrogen compound contained in suspended particulates as well as through the determination of fluorine in plant leaves. The method used for the determination was that proposed by Thompson et al. (JAPCA,21(8) 484-487(1971)). The content in air was 0.211-1.012 micrograms/cu m and the origin of this fluorine was the factory wastes. The correlation between fluorine and various heavy metals such as iron, manganese, and zinc was meaningful. The fluorine content in the leaves of sultan s parasol, Firmiana platanifolia, was 2.30-39.62 micrograms/g leaves. The concentration increases as the location of a tree neared the factory. The values obtained by the colorimetric method and by the ionic electrode method agreed well with each other. Therefore, the ionic electrode method is superior to the other because this method is simpler. Comparison was also made of the Smith method and the Jacobson method.

61570

Kubota, Torahide

DEVELOPMENT OF POLYMER CHEMICAL INDUSTRY AND ITS ASSESSMENT FROM THE STANDPOINT OF POLLUTION. (Kobunshi kagaku kogyo no hattan to kogai kara no asesumento ni tsuite). Text in Japanese. Kankyo Sozo (Environ. Creation), 4(4):27-36, April 1974.

Air pollution control plans required of plastic industries include inspections of monomer synthetic process by-products and their toxicity, toxicity of refining low-boiling point gas, photochemically reactive gas, polymer process separation gas, plastic waste incineration combustion gas, and treatment of all these harmful gases. Industries are responsible for producing potentially toxic material by utilizing materials including hydrogen chloride, heavy metals, nitrogen oxide, sulfur oxides, and dusts. Plastic products and potential pollutants, plastic coloring materials and pollution factors, and various polymer compound additives and pollutants are presented in

tables. Even with photodegradable plastics and radio-degradable materials, food, air, water, and human health are threatened, especially if degradation occurs while the products are still in use. Degraded materials still produce HCl, hydrogen fluoride, ammonia, COCl2, carbon monoxide, and formaldehyde. The better the product, the harder the treatment and the more chances for pollution; therefore, the future of polymer products must be based on the environmental safety even it it means inferior products. The distribution-sales flow must include recovery and reuse, and the manufacturing process must include material recovery and recirculation systems.

61800

Beising, R. and H. Kirsch

THE BEHAVIOR OF THE TRACE ELEMENT FLUORINE FROM FOSSIL FUELS AT THE COMBUSTION. (Das Verhalten des Spurenelementes Fluor aus fossilen Brennstoffen bei der Verbrennung). Text in German. VGB Kraftwerkstechnik, 54(4):268-286, April 1974. 61 refs.

Fluorine is in coal largely bound to the mineral fraction. In the Ruhr coal, the fluorine concentration amounts to between 15 and 210 ppm, soft coal from the lower Rhine contains only 3 to 28 ppm fluorine. Solubility experiments with coal showed a mobility of the F-ions in the water-containing coals. Only a small fraction of the fluorine in the coal stems from the original plant material, the main fraction is found in the illites. In the cyclone melting furnace fired by hard coal which was examined, the fluorine evaporates entirely from the liquid slag. The fluorine concentration in the fly ash collected in the dust collectors may reach as much as 1100 ppm. In soft coal-fired furnaces with dry ash tap-off, about one fourth of the fluorine is retained in the fly ash in the electrostatic precipitator. The largest local fluorine concentration (2200 ppm) was found in the thin deposits on the combustion chamber walls. In the examined furnaces, with the exception of the soft coal fired boilers, the fluorine concentration in the ash increases with decreasing flue gas temperature from zero to 2700 ppm. At a flue gas temperature above 900 C, no fluorine is bound in the deposits. The fluorine ions in the fly ash from soft coal- and hard coal-fired boilers showed a relatively low water solubility. In the literature it is generally assumed that from power plants, the fluorine escapes largely in gaseous form as hydrogen fluoride and silicon fluoride. The formation of HF is promoted by the high water concentration of the flue gases. The present examinations revealed that fluorine is largely bound to the octahedron layer of the clay mineral as a replacement of hydroxyl ions. Under the conditions of the combustion chamber they leave the disintegrating structure and form HF.

63661

Zhukov, V. I., T. N. Livke, P. K. Zaika, I. I. Voldayeva, and M. V. Gavrilyuk

WAYS OF ABATING GASEOUS AND PARTICULATE POLLUTANT CONCENTRATIONS IN THE AIR IN THE CHEMICAL INDUSTRY. (Puri snizheniya zagazovannosti i zapylennosti vozdukha na predpriyatiyakh khimicheskoy promyshlennosti). Text in Russian. Khim. Prom. (Moscow), no. 5:371-372, 1974.

Results of workplace pollutant concentration measurements in chemical plants, and measures planned or taken for emission abatement in such plants are described. The sulfur dioxide, dust, and nitrogen dioxide concentrations measured in a sulfuric acid production plant were in excess of the maximum allowable concentrations in 8.5%, 7.2%, and 37.7% of all cases, respectively. The hydrogen phosphide, dust, hydrofluoric acid concentrations in a phosphate fertilizer plant exceeded the limit values in up to 70% of all cases. An epidemiological survey conducted among the workers revealed that pneumonia was responsible for 30% of all diseases, while the respective shares of the diseases of the upper respiratory tract, of bronchitis, and gastrointestinal affections were 27%, 2%, and 5%, figures that are indicative of the predominant influence of dust. Wet method and closed cycle operation in a phosphate processing plant, the use of centrifugal scrubbers in a superphosphate manufacturing plant, and alkaline adsorption of phosphates for the reduction of the fluoride emissions, as well as ozone-catalytic purification and the use of fibrous filters for the reduction of the SO2, sulfur trioxide, and sulfuric acid production plant are among the principal measures taken so far for pollution abatement.

64926

Schoenmaker, Oswald Dirk and Jacobus Philippus Guldenmundt

USE OF PUROFER SPONGE IRON IN A 35-TON ELECTRIC ARC FURNACE. (Einsatz von Purofer-Eisenschwamm in einem 35-t-Elektroofen.) Text in German. Stahl Eisen (Duesseldorf), 94(16):711-728, Aug. 1974. 3 refs.

The emissions from the charging of sponge iron in an electric furnace were examined. Dust emission measurements were taken in the suction tube 26m from the furnace. The furnace waste gases are afterburned and cooled by surplus air. The first portions of the suction tube are water cooled. At the measuring point the temperature was 500 to 700 C. During scrap melting a maximum of 10 to 14 g of dust/cu m and an average of 6 g/cu m were measured. The continuous addition of sponge iron increased the maximum values to 20 to 21 g dust/cu m and the average to 9.0 g/cu m at a sponge iron fraction of 72 to 80%. Of the measured dust during sponge iron melts 60% had a grain size of less than 5 micron, while this fraction was only 30% during scrap melts. Understandably the fractions of silica, alumina, and titanium dioxide, as well as calcium oxide and magnesium oxide were higher during the treatment of sponge iron while the fractions of tin, zinc, lead, manganese, sodium oxide, fluorine, and water soluble chlorine were low.

65064

Gerstle, Richard W. and Robert S. Amick

STAUFFER CHEMICAL COMPANY, MT. PLEASANT, TENNESSEE. PEDCo-Environmental Specialists, Inc., Cincinnati, Ohio, Environmental Protection Agency Contract 68-02-0237, Test 72-MM-04, Task 4, 99p., 1972 (?).

Atmospheric emissions of fluorides and phosphorus pentoxide from Stauffer Chemical Company s elemental phosphorus plant in Mt. Pleasant, Tenn., were sampled to form a data base for New Source Performance Standards as authorized by Celan Air Act of 1970. Tests were made to determine fluoride and P2O5 concentrations at the inlet and outlet of the venturi scrubber serving the furnace slag tapping operations. Fluoride concentrations before the venturi scrubber were generally in the range of 0.026 to 0.029 gr/SCF. Phosphorus pentoxide concentrations ranged from about 0.055 to 0.066, gr/SCF. After the scrubber, fluorides ranged from 0.00103 to 0.00131 gr/SCF and P2O5 concentrations were in the 0.012 and 0.016 gr/SCF range. Stack gas velocities, temperatures, moisture, carbon dioxide, oxygen, and carbon monoxide content were also measured.

66955

Ministry of International Trade and Industry and Hokkaido-Tomakomai Municipal Government

A REPORT ON THE PRELIMINARY INVESTIGATION FOR THE INDUSTRIAL DEVELOPMENT OF THE TOMAKOMAI AREA (AIR POLLUTION). (Tomakomai chiku sangyo kogai sogo jizen chosa (taiki kankei) hokokusho). Text in Japanese. Sangyo Kogai (Ind. Public Nuisance), 10(8):59- 69, Aug. 1974.

Tomakomai city which has been the center of paper pulp, wooden products, and lumber industries is changing into a heavy and chemical industrial area. With the development of industrial conglomerates of aluminum-electric power-oil refinery-petrochemicals, the pollution problems are increasing. The sulfur oxides concentration measured by the lead dioxide method showed a localized pollution in the vicinity of paper mills, and the yearly average SOx concentration measured by the conductimetric method was relatively low and below the environmental standard. The settling particulate concentrations measured in 1971 and 1972 did not show much increase compared to those in preceding years. The high hydrogen fluoride concentration was localized in the vicinity of an aluminum refinery. The relationships between meteorological factors and pollution were analyzed in regard to the wind direction frequency (wind rose) and distribution of wind velocity. The estimation of atmospheric pollutant concentration was based on data on future operations submitted by each industry by means of wind tunnel dispersion tests and theoretical equations of dispersion. The maximum SOx concentrations calculated based on the original industrial development plan were 0.389 ppm at E wind and 0.293 at S wind, exceeding the environmental standard. Recommendations for SOx pollution control by means of conversion to low sulfur content fuel, desulfurization processes, and increase in stack height were issued. With the cooperation of industry, it is now certain that the SOx concentration can be maintained below the environmental standard.

66977

Deysing, Guenter

THE DEVELOPMENT OF POLITICAL ECONOMY IN THE DISTRICT COTTBUS AND THE TASKS RESULTING FROM IT FOR THE SOCIALIST SOCIETY IN THE COUNTRY. (Die Entwicklung der Volkswirtschaft im Bezirk Cottbus und die sich daraus ergebenden Aufgaben fuer die sozialistische Landeskultur). Text in German. In: Technick und Umweltschutz Luft - Wasser - Boden - Laerm, Luftverunreinigung bestimmter Gebiete und technologische Verfahren zur Emissionsverminderung. Vol. 5, Leipzig, VEB Deutscher Verlag fuer Grundstoffindustrie, 1974, p. 11-18.

The district Cottbus supplied in 1970 35% of East Germany s electric power which by 1975 will have risen to 44%, 51% of the demand for soft coal which will rise to 58% by 1975, and 53% of the city gas which will rise to 65%. The further industrialization and the increasing population density in the cities, primarily in the Eastern part of the district of Cottbus, lead to enormous air pollution problems. Power generation and coal refining cause emission of dust, sulfur dioxide, oxides of nitrogen, phenols, hydrogen sulfide, ammonia, organic sulfur compounds, and other odorous substances. The sizable glass and ceramic industry emits dust, sulfur dioxide, oxides of nitrogen, fluorine compounds, lead, and sulfur trioxide. Other industrial branches operating in the district Cottbus and emitting a broad spectrum of pollutants are the chemical, textile and food industries, and metal working plants. The availability of waste gas cleaning facilities is presently at 75% and great efforts have been made to raise it to 95%. Industry operates 170 measuring stations in the areas Luebbenau, Vetschau, Boxberg, Knappenrode, and Laubusch and the Institute for Hygiene operates 90 measuring stations. The results from these measurements aid the selection of air cleaning systems.

67748

Office of Air and Waste Management, Research Triangle Park, N. C., Emission Standards and Engineering Div.

BACKGROUND INFORMATION FOR STANDARDS OF PERFORMANCE: PHOSPHATE FERTILIZER INDUSTRY. VOLUME 2: TEST DATA SUMMARY (FINAL REPORT). Rept. EPA 450/2-74-019b, 62p., Oct. 1974. 33 refs. NTIS: PB 237607/AS

Background information on the derivation of performance standards for the phosphate fertilizer industry is presented in connection with a first volume which provided a general description of the facilities for which standards were proposed. Summaries of emission testing data cited in Volume I are presented and are concerned principally with tests for fluorides and visible emissions. The facilities, characteristics of the exhaust gas streams, and conditions of operation are also described. Types of facilities covered in the document include: wet-process phosphoric acid plants, superphosphoric acid plants, diammonium phosphate plants, run-of-pile triple superphosphate plants, granular triple superphosphate plants, and storage of granular triple superphosphate. Many of the tests summarized were conducted using the Environmental Protection Agency Method 13 which will be proposed in the Federal Register at or before the time of proposal of the performance standards.

67806

California Air Resources Board

A FINAL REPORT ON AN EMISSION INVENTORY AT KAISER STEEL. Rept. 73-20-5, 15p., Sept. 18, 1973.

An emission inventory of sources at Kaiser Steel and a schedule for compliance for each source not now in compliance with San Bernardino County Air Pollution Control District regulations were developed. The total emissions from the Kaiser Steel plant in tons/day and tons/yr of the various air pollutants, and the percentage of contribution of most of these emissions to the total emission inventory for San Bernardino County are tabulated. The District has no countrywide information on the emissions of hydrogen sulfide, ammonia, or gaseous fluoride. The total emissions are these: particulate matter 11.4 tons/day, 4161 tons/yr; sulfur dioxide 27.9 tons/day, 10,184 tons/yr; oxides of nitrogen as nitrogen dioxide 13.5 tons/day, 4928 tons/yr; carbon monoxide 98.7 tons/day, 36,026 tons/yr; organic compounds as methane 7.7 tons/day, 2811 tons/yr; H2S 0.2 tons/day, 73 tons/yr; NH3 0.5 tons/day, 183 tons/yr; and gaseous fluoride 1.0 tons/day, 365 tons yr. Most of the emissions of particulate matter, organic compounds, H2S, and NH3 are from published emission factors or engineering estimates and most of the emissions of SO2, NOx, CO, and gaseous fluorides are from source test data.

67834

Office of Air and Waste Management, Research Triangle Park, N. C., Emission Standards and Engineering Div.

BACKGROUND INFORMATION FOR STANDARDS OF PERFORMANCE: PRIMARY ALUMINUM INDUSTRY. VOLUME 2: TEST DATA SUMMARY (FINAL REPORT). Rept. EPA-450-2-74-020b, 51p., Oct. 1974. 17 refs. NTIS: PB 237613/AS

A summary is presented of source tests and visible emission measurements which were cited in Technical Report: An investigation of the Best Systems of Emission Reduction for the Primary Aluminum Industry. The summary is concerned principally with tests for fluorides and visible emissions but also describes the facilities, their operating conditions, and characteristics of exhaust gas streams. Average primary outlet emissions (fluorides) for 11 primary aluminum facilities tested were: 0.0122, 0.016, 0.28, 0.405, 0.50, 0.139, 0.448, 0.51, 0.04, 0.74, and 0.31 lbs/ton of product. Roof emissions (fluorides), secondary outlet fluorides, and visible emissions are also tabulated. Many of the tests were conducted using the Environmental Protection Agency Method 13 which will be proposed in the Federal Register at the time of proposal of the performance standards for new or substantially modified primary aluminum plants.

67940

Galantai, Pal

STATE OF ART, AND CURRENT TASKS AND PROBLEMS OF ENVIRONMENTAL PROTECTION IN KOMAROM COUNTY (HUNGARY). (A kornyezetvedelem helyzete, idoszeru kerdesei, feladatai, Komarom megyeben). Text in Hungarian. Tatabanyai Szenbanyak Muzaki-Kozgazdasagi Kozl., no. 2-3:55-60, April-Sept. 1974.

The state of the art of environmental pollution, as well as current achievements and tasks in environmental protection in Komarom county, the most industrialized area in Hungary, are presented. While being one of the most polluted counties in Hungary, Komarom county is in an advanced position in environmental protection, and the measures currently taken are preventive rather than reparative in nature. Dust, sulfur dioxide, fluorine, and malodorous emissions are principally responsible for air pollution. Thermal power plants, cement works, alumina factories, mines, and a vitamin B12 fermenting plant are the chief sources of pollution. A large-capacity cement work is being equipped with electrostatic precipitators for dust emission control. The malodorous substances generated in the vitamin B12 fermenting plant will be destroyed by incineration.

68703

Balogh, Erno

AIR POLLUTION IN TATABANYA AND METHOD OF AIR POLLUTION STUDY FOR INDUSTRIAL AREAS. (Tatabanya levegoszennyezodese es az iparvidekek levegoszennyezettsegenek vizsgalati modszere). Text in Hungarian. Tatabanyai Szenbanyak Muszaki-Kozgazdasagi Kozl., no. 2-3:69-73, April-Sept. 1974. 15 refs.

An inventory is presented of the air pollutant emissions in the Tatabanya region, Hungary, and a general method for the study of air pollution in industrial areas is outlined. Fly ash, dust, sulfur dioxide, and fluorides are the chief pollutants emitted in this industrial area that consumes 1,160,000 tons of coal yearly. A thermal power plant, equipped with electrostatic precipitators for fly ash separation, emits fly ash and SO2, a gaseous pollutant for whose removal there is currently no economically acceptable method available. It will be possible to abate the dust emission from a large-capacity cement works by the use of electrostatic precipitators. It was possible to reduce the SO2 concentration peak from 5 mg/cu m to 0.3 mg/cu m by increasing the stack height from 50 m to 160 m at a power plant. This change also resulted in a shift of the site of the peak concentration to a greater distance from the emission source. The automotive exhaust-generated air pollution, though increasing, is well below the allowable level. The expansion of residential areas with long-distance heating systems is a valuable contribution to air pollution abatement. The expectable ground-level concentrations can be estimated from the pollutant discharge on the basis of wind speed and wind direction distribution.

68807

Kaurov, P. I., U. K. Bakirov, and O. A. Bogayevskiy

VENTILATION OF ALUMINUM ELECTROLYSIS SHOPS. (Provetrivaniye tsekhov elektroliza alyuminiya). Text in Russian. Bezop. Tr. Prom., no. 11:37-38, 1972.

Problems of ventilation and air pollution control in aluminum electrolysis shops are described. In one electrolysis shop, the air discharged contains 2.1 mg fluorides, including 0.7 mg hydrofluoric acid per cu m. Ventilation due to the heat released by the electrolyzers is insufficient as it is controlled mostly by the wind with the aeration pressure not exceeding 0.5 mm of water column. Therefore, mechanical ventilation, especially exhaust ventilation, must be provided for along with conditioning of the incoming air and purification of the exhaust.

68823

Office of Air and Waste Management, Research Triangle Park, N. C., Emission Standards and Engineering Div.

BACKGROUND INFORMATION FOR STANDARDS OF PERFORMANCE: PRIMARY ALUMINUM INDUSTRY. VOLUME 1: PROPOSED STANDARDS. Rept. EPA-450/2-74-020a, 122p., Oct. 1974. 13 refs. NTIS: PB 237612/AS

The proposed standards of performance for primary aluminum plants and the rationale for the degree of control selected are described. Analytical methods for sampling emissions and the environmental and economic impact of the standards are discussed. During initial plant surveys, source measurements, and a later visit to Norway, seven primary aluminum reduction plants were observed to have visible emissions of about 10% opacity or less; four with dry control systems had no visible emissions. One domestic carbon anode bake plant had visible emissions of less than 20% opacity; another domestic plant had 10%. The Norwegian anode bake plant had about 10%. The primary standard was based on primary emissions which averaged less than 0.5 lbs TF/TAP (total fluoride/ton of aluminum produced) which were achieved on four plants; one foreign plant reported primary emissions of less than 0.5 lb TF/TAP. Three of the six tests of secondary systems showed average emissions of less than 1.25 TF/TAP, including two plants with elaborate sampling and flow measurement devices. Based on an assumed fluoride control efficiency of only 90%, emissions from carbon bake plants can be controlled to below 0.20 lb TF/TCAP. Data were obtained from plants in which the collection systems were upgraded and control systems retrofitted to an existing plant. New plants should easily be able to achieve the recommended standard of performance. The economic impact upon the domestic primary aluminum industry of the standards is not considered to be adverse. The economic impact would be adverse if more stringent standards were to be imposed upon the industry. The proposed standard of 2.0 lb/TF/TAP is supported by measurement of emissions from potrooms. Control technology for anode bake plants is available to achieve 0.20 lb TF/TCAP. The standard will require installation and proper maintenance of equipment representative of the best technology which has been demonstrated for the industry. (Author summary modified)

68912

Shacklette, Hansford T., Josephine G. Boerngen, and John Keith

SELENIUM, FLUORINE, AND ARSENIC IN SURFICIAL MATERIALS OF THE CONTERMINOUS UNITED STATES. U. S. Geol. Surv. Circ., no. 692: 1-14, 1974. 33 refs.

Concentrations of selenium, fluorine, and arsenic in 912, 911, and 910 samples, respectively, of soils and other regoliths from sites approximately 50 miles apart throughout the U. S. are represented on maps by symbols showing five ranges of values. Histograms of the concentrations of these elements are also given. The geometric mean concentrations in the samples are 0.31, 0.25, and 0.39 ppm selenium for the entire U. S., the western U. S., and the eastern U. S., respectively; 180, 250, and 115 ppm fluorine, respectively; and 5.8, 6.1, and 5.4 ppm arsenic, respectively. Selenium in soils may be derived from parent material weathered from the underlying rock, from wind- or water-deposited seleniferous materials, from ground or surface water by precipitation, from volcanic emanations brought down by rain, and from sediments derived from mining operations. Fluorine is added to soils from atmospheric fallout from industrial activity, by volcanic ejecta, or by the application of phosphate fertilizers and other fertilizers containing slag. Arsenic in soils can result from agricultural practices, industrial operations, burning of coal ash containing As, smelters, and arsenic insecticides. The analytical methods used to determine selenium, fluorine, and arsenic were X-ray fluorescence, fluoride specific-ion electrode, and spectrophotometric-isotope dilution methods, respectively. (Author abstract modified)

69039

Waldbott, G. L. and W. Oelschlager

FLUORIDE IN THE ENVIRONMENT. Fluoride Quart. Repts., 7(4):220-222, Oct. 1974. 3 refs. (Presented at the 5th I.S.F.R. Conference, April 8-11, 1973.)

Preliminary data on determinations of fluoride in tobacco, detergents and other cleaning materials, certain kinds of dusts (wood, steel, fiberglass, and asbestos), pollen grains, and fertilizers are presented. The data concern mainly items to which one is exposed occupationally. Relatively large amounts of fluoride are found in fiberglass and its presence could be a factor in the irritating action of fiberglass on the mucous lining of the upper respiratory tract. Fluoride contained in steel dust is not likely to induce symptoms in humans, though fluoride might conceivably influence the production of red lung which is primarily caused by airborne iron oxide. Similarly, the presence of fluoride in asbestos might be a factor in the action of asbestos bodies in the lungs. Fluoride is present in minute quantities in pollen grains (approximately 3 ppm); not much pollen is likely to reach the lower air ways due to the size of the pollen (20-60 microns). Fluorides in detergents can reach certain food products when food-handling containers are not sufficiently rinsed. A person who smokes 50 cigarettes per day is estimated to inhale approximately 0.8 mg fluoride as compared to the 8-hour maximum allowable concentration values of 2.5 mg/cu m. Most occupational diseases are aggravated by smoking and even relatively minute amounts of tobacco smoke may, under certain conditions, contribute to respiratory illness.

69309

Vogl, J.

THE EMISSION INVENTORY AND THE NECESSITY OF DETERMINING THE EMISSIONS SPECIFIC TO VARIOUS INDUSTRIAL BRANCHES AND PRODUCTION PROCESSES. (Das Emissionskataster und die Notwendigkeit der Ermittlung branchen- und produktionsspezifischer Emissionen). Text in German. Gesundh.-Ingr., 95(9):251-253, 1974. (Paper presented at the second Symposium on Branch-specific Emissions, Fluorine Emissions by Brick Kilns, Munich, Germany, Feb. 1, 1974.)

In order to gain information on the air quality of a certain area a detailed emission inventory is required for which extensive data on the spatial distribution as well as size and type of single emission sources must be gathered. Although collection of these data has begun in Bavaria it is reckoned, that it will take several years to complete the emission inventory. For this reason, available sources of information as well as model calculations and approximations have to be used for working out the planned emission protection program. The emission inventory must include the emission sources such as industries, fossil and nuclear fuel-operated power production plants, domestic heaters, and automobiles. For determining the emissions by industrial production facilities existing statistical data such as density of industries in the area and throughput must be used, which is risky with regard to accuracy. The inaccuracy can be reduced somewhat if a differentiation of the various production processes is introduced. The the creation of the emission protection program in Bavaria only sulfur dioxide, oxides of nitrogen, hydrocarbons, carbon monoxide, hydrogen fluoride, and dusts are taken into account. For better comparison of the pollution in various regions an evaluating scheme on the basis of an emission matrix was used which groups the various emission sources according to type and quantity of emitted pollutants into four categories and with which the emissions by each individual industrial branch can be determined.

69353

Wilson, H. H. and L. D. Johnson

CHARACTERIZATION OF AIR POLLUTANTS EMITTED FROM BRICK PLANT KILNS. Preprint, Environmental Protection Agency, Research Triangle Park, N. C., Particulate and Chemical Processes Branch, 15p., 1973 (?). 15 refs.

Stack gases analyses and emission factors were obtained for four brick plants selected as extreme cases of pollutant emitters. Each of the four plants used tunnel kilns fired with natural gas. Average stack gas concentrations for the four plants ranged from 32.0-359 mg/cu m for nitrogen oxides, 121-2690 mg/cu m for sulfur dioxide, 17.9-71.8 mg/cu m for sulfur trioxide, 31.7-162 mg/cu m for fluorides, 2.1-13 mg/cu m for chlorine, and 8-56 mg/cu m for particulates. Chemical analyses of plume particulates presenting visible emissions (opacities as high as 15%) identified the particulate emissions as mixtures of ammonium bisulfate and ammonium sulfate. Emission factors for the four plants ranged from 157-2668 mg/kg brick for sulfur dioxide, 22.5-99.4 mg/kg for sulfur trioxide, 79.9-549 mg/kg for fluorides, and 113-501 mg/kg for chlorine. These factors were computed from chemical analyses of raw and fired materials rather than from the stack analyses and production rates.

69422

Brocke, W.

ENVIRONMENTAL POLLUTION BY CONVENTIONAL POWER PLANTS. AIR POLLUTION CAUSED BY CONVENTIONAL POWER PLANT EMISSIONS. (Umweltbelastung durch konventionelle Kraftwerke. Die Luftbelastung durch Emissionen konventioneller Kraftwerke). Text in German. Strahlenschutz Forsch. Prax., vol. 12:67-76, 1973. (Presented at the Association of German Radiation Protection Physicians and

the Association for Radiation and Environmental Research, 12th Conference, Munich and Neuherberg, West Germany, Oct. 8-9, 1971.)

Data on the contribution of conventional thermal power plants to air pollution is presented. Particulate matter, sulfur dioxide, sulfur trioxide, gaseous fluorine compounds, carbon monoxide, nitric oxide, nitrogen dioxide, and gaseous organic compounds are the chief pollutants emitted by combustion equipment firing fossil fuel. Assuming that no improved emission control measures relative to the current practice will be implemented, the particulate emission is expected to increase by 13% in the 1970- 1980 period in West Germany, and increase by 22% for sulfur oxides, 18% for fluorine compounds, 34% for nitrogen oxides, 35% for CO, and 13% for organic compounds. Stationary combustion equipment is responsible for some 88% of the total SO2 emission in West Germany and power plants are responsible for 70% of all fluorine emissions. The CO and organic emissions by power plants are not significant relative to those generated by automobiles and other industries. The specific pollutant emission is highest for soft coal-fired power plants.

70069

Engineering-Science, Inc., McLean, Va.

AIR POLLUTION EMISSION TEST. U.S.S. AGRI-CHEMICALS. NASHVILLE, TENNESSEE. Office of Air Programs Contract 68-02-0225, Task 15, Rept. 73-FRT-7, 26p., Nov. 1974.

Source emission tests were conducted at the U.S.S. Agri-Chemical phosphate fertilizer plant in Nashville, Tennessee during the week of May 21, 1973 to provide data for establishing Federal emission standards for new sources in the phosphate fertilizer industry under Section 111 of the Clean Air Act of 1970. The methods used and results obtained in the test series are described. Twelve samples were obtained for each of the following emissions: particulates, ammonia, and total fluorides. Samples were obtained from the dryer kiln/cooler baghouse and from the ammoniator scrubber. Simultaneous sampling of both the inlet and outlet gas streams of each control device was conducted. In addition to these gas stream samples, grab samples of scrubber liquid, phosphate rock, and granulated fertilizer product were periodically taken. The sampling and analytical procedures, process operation, location of sampling ports, and test results are described.

70727

Truhaut, R., P. Bourbon, and J. Alary

FLUORIDE EMISSIONS FROM TREATMENT OF NATURAL PHOSPHATES IN THE PRODUCTION OF FERTILIZER. Fluoride Quart. Repts., 8(1):25-33, Jan. 1975. 6 refs.

Emissions from a fertilizer plant manufacturing super, triple, binary MAP and DAP and NPK fertilizer are discussed. The total fluoride emission corresponds to a mean of 100 kg of fluoride/day. The levels of fluoride in the environment were determined during a period of 2 yr at four sampling points situated within a radius of about 1 km from the facility. The values obtained varied between 0 and 10 micron fluoride/cu m. The mean value was close to 2 micron/cu m in total fluoride. Dust analysis in the immediate vicinity showed that about 40% of the collected dust contained apatite derived essentially from the unloading of the minerals. This much fluoride pollution caused necrosis in plants. Fluoride ion ranging from 10 to 200 ppm was found in 50 specimens of sensitive plants. Fluoride ion emission limits are proposed for agricultural areas 1, 2, 3, 5, and 4.5 ppb for periods of 1 mo, 1 wk, 24 hr, and 12 hr, respectively.

71262

Bethea, Robert M.

INTERRELATIONSHIPS BETWEEN AGRICULTURE AND AIR POLLUTION. Air Pollution Control Assoc., Pittsburgh, Pa., Southern Section and Technical Council, Control Technol. Agric. Air Pollut., Memphis, Tenn., 1974, p. 1-15. 31 refs. (March 18-19.)

An overview of the interrelationships between agriculture and air pollution is presented. Agricultural sources of particulate and gaseous air pollutants include: rendering operations (odors), confined feeding areas (odorous animal wastes), cotton ginning (particulates), and feed production (particulates). The odor- causing pollutants consist of such compounds as sulfides, mercaptans, ammonia, ketones, and organic acids. Potential control routes for agricultural emissions include: scrubbing processes, incineration, particulate collection with devices such as cyclones or fabric filters, and proper maintenance of agricultural operations. Air pollutants affecting agricultural operations (plants, animals, and agricultural workers) include: sulfur oxides, sulfates, sulfuric acid (acid rains), nitrogen oxides, fluorides, various trace metal compounds, halogens, hydrocarbons, sulfides, mercaptans, cyanides, ozone, ammonia, and halogenated hydrocarbons (e.g., pesticides).

71273

Heggestad, H. E.

AIR POLLUTANTS FROM, AND EFFECTS ON, AGRICULTURE. Air Pollution Control Assoc., Pittsburgh, Pa., Southern Section and Technical Council, Control Technol., Agric. Air Pollut., Memphis, Tenn., 1974, p. 170-177. 8 refs. (March 18-19.)

An overview of the problem of air pollution generation from agriculture and the effects of air pollutants on agricultural activities is presented. The most important air pollutants generated from agricultural operations include: pesticides, dust, smoke from open burning, allergens, odors, and volatilized nitrogen products. Volatilization is a major pathway for the escape of many gaseous pollutants from farm areas. Compared to the effects of air pollutants from transportation, stationary sources, and industry, air pollutants from agricultural processes has relatively little impact on the crops. Over 80% of agricultural losses due to air pollution are caused by photochemical oxidants. Sulfur dioxide is the most important air pollutant affecting vegetation from a point source. Fluoride injury to vegetation is important in localized areas and is responsible for fluorosis in sheep and cattle.

71477

Hoelsken, H.

HAZARDS DUE TO GASES, VAPORS, AND SMOKES. (Gefahren durch Gase, Daempfe, Rauche). Text in German. Schweisstechnik (Vienna), 28(11):228-230, 1974.

Harmful emissions generated during welding operations and appropriate protective measures are described. Arc-welding operations are accompanied by iron oxide, manganese oxide, silica, calcia, and fluoride emissions, depending on the type of the wire used. Smoke generated during arc-welding contains 30-40% iron oxides, 24-26% silica, 7-25% manganese oxides, 15% calcia, and 22% fluorides. In addition, lead and zinc emissions can be generated when welding is performed on surfaces with lead- and zinc-containing finishes. Inhaled iron oxides may cause siderosis and hemosiderosis, while manganese oxides may cause pneumonia and lesions of the nervous system. No free crystalline silica is generated by arc-welding. Shielded arc welding operations generate metal vapors, ozone, nitrous

gases, and fluorides. Carbon dioxide used as a protective gas may form carbon monoxide at high temperature. While CO2, either as a protective gas or as a combustion product is harmless, it may be hazardous especially in limited spaces by displacing air. Periodic ventilation is necessary during welding operations, and local exhaust systems are required for welding in limited spaces, such as in tanks, to prevent the accumulation of poisonous gases such as CO, nitrogen oxides, and ozone.

71615

Davids, Peter and Kurt Gerhards

REFUSE COMPOST PLANTS: REFUSE COMPOSITION AND EMISSIONS FROM INCINERATORS FOR RESIDUAL MATTER. (Ergebnisse von Muelluntersuchungen und Emissionsmessungen a Resteverbrennungsanlagen in Muellkompostwerken). Text in German. Umwelthygiene, 25(12):273-277, 1974. 5 refs.

Trash composting plants yield residual matter which may reach up to 20% of the composted trash. This residual matter must be either tipped or incinerated. It contains a high amount of plastics which raises the hydrogen chloride emission in incinerators. However, in most cases the residues from trash composting are incinerated together with bulky refuse and industrial waste products so that about the same HCl content has been measured in these special incinerators as in large trash incinerators. The hydrogen fluoride emission was higher in incinerators for composting residues than in normal trash incinerators, which was due to the higher heating value of this matter. The dust removal problem of incinerators for composting residues is identical with that of large trash incinerators. Through installation of electrostatic precipitators the emission limit of 100 mg/cu m (referred to an oxygen content of the waste gas of 11%) can be met. Venturi scrubbers are usually installed for the reduction of HCl and HF emissions. The cleaned gases contained on the average less than 2 mg HF/cu m and less than 100 mg HCl/cu m.

72079

Csinady, Laszlo

RELATIONSHIPS OF ENVIRONMENTAL PROTECTION AND PUBLIC HYGIENE. (A kornyezetvedelem es kozegeszsegugy osszefuggesei). Text in Hungarian. Tatabanyai Szenbanyak Muszaki-Kozgazdasagi Kozl., 14(2-3):89-92, April-Sept. 1974. 11 refs.

General environmental and hygienic problems of the highly urbanized and industrialized Komarom County in Hungary are described. Industries, mining, power plants, and domestic heating are responsible for very high pollution levels, making this county the most polluted one in the entire country. Air pollution due to settling dust, sulfur dioxide, and fluorides is most problematic, and the situation is aggravated by the promiscuously intertwined industrial and residential areas. The incidence of respiratory tract diseases is highest in this county.

72125

Shimoda, M. and T. Oono

INVESTIGATION OF NOX AND OTHER POLLUTANTS EMITTED FROM STATIONARY SOURCES, IV: ELECTRIC ORE FURNACE. (Kotei hasseigen kara hassei suru chisso sanka-butsu nado oen bushitsu chosa. (IV) Denkiro). Text in Japanese. Taiki Osen Kenkyu (J. Japan. Soc. Air Pollution), 9(2):409, Nov. 1974. (Presented at the National Air Pollution Research Conference, 15th, Chiba, Japan, Nov. 6-8, 1974, Paper 260.)

The emission of nitrogen oxides, total hydrocarbons, dust, and hydrogen fluoride from electric ore furnaces was measured. In the case of small scale electric ore furnaces (less than 10 tons/ch), the NOx concentration was less than 2-10 ppm, total emission quantity was less than 0.1 N cu m/hr, and eF was about 0.096 kg/ton. As for the medium scale furnace (10-30 tons/ch), the NOX concentration increased to 200-300 ppm instantaneously at arcing; however, the average concentration was several ppm, total emission quanity was 0.2-0.3 N cu m/hr, and eF was about 0.033 kg/ton. In the case of large scale furnaces (over 30 tons/ch), the occurrence frequency of instantaneous high NOx concentration (400 ppm) was increased. The average concentration was less than 20 ppm, total emission quantity was 0.7-1.7 N cu m/hr, and eF was about 0.016 kg/ton. The inlet dust concentration was as high as 14-0.4 kg/N cu m, but can be treated effectively by the use of a local hood or direct suction dust collector. The eF was about 2.1-56.9 kg/ton. The total HC emission increased instantaneously at ignition. The averate concentration was 2-3 ppm, and eF was about 0.004 kg/ton. The HF measured after the addition of fluorspar showed no sign of HF emission. The variation in NOx dust concentration in one cycle of operation was also measured.

72133

Grimbergen, M. van, G. Reybrouck, and H. van de Voorde

AIR POLLUTION DUE TO THE BURNING OF THERMOPLASTICS II. (Luftverunreinigung, verursacht durch die Verbrennung von Kunststoffen II). Text in German. Zentralbl. Bakteriol. Hyg., Infektionskr. Abt. Orig. B, 160(2):139-147, 1975. 14 refs.

Thirteen chemically pure polymers were burnt in an electric oven to determine the level of solid and gaseous air pollution caused by their stack gases. All 13 polymers are highly combustible but require different burning temperatures (300-900 C) in order to be burnt completely. With the exception of polymethylmethacrylate (PMMA) and polytetrafluoroethylene (PTFE), all plastics leave a very heavy tar and soot deposit after burning. Burning at low temperature (300 C) gives rise to high concentrations of aliphatic aledhydes. The pH of the exhaust gases, dissolved in water, is neutral to strong acid (PTFE) and will cause severe corrosion. The nitrogen-containing polymers pollute by forming cyanides, nitrogen oxides, and ammonia. High concentrations of fluoride are given off by PTFE, PMMA decomposes in its monomer methylmethacrylate and forms large amounts of aliphatic aldehydes, while ABS (acrylonitrile-butadiene-styrene) and SBR (styrene-butadiene- rubber) cause styrene pollution.

73078

Hall, H. J., G. M. Varga, ... E. M. Magee

TRACE ELEMENTS AND POTENTIAL POLLUTANT EFFECTS IN FOSSIL FUELS. In: Symposium Proceedings: Environmental Aspects of Fuel Conversion Technology (May 1974, St. Louis, Missouri). Research Triangle Inst., Research Triangle Park, N. C., Environmental Protection Agency Contract 68-02-1325, Task 6, Program Element 1AB013, Rept. EPA-650/2-74-118, ROAP 21ADD, 21AFJ, p. 35-47, Oct. 1974.

Trace elements in coal and their potential pollutant effects are discussed. Many elements are present at about 1-100 ppm in all regions, and vary by a factor of 3 or less in the averages for different basins or areas. The usual amount of some 20 trace elements measured is about 5-10 ppm. Boron and fluorine are higher, at about 50 to 200 ppm; mercury is lower, about 0.01 to 0.5 ppm. The volatile hazardous elements show the most need for more data. Some or all of these may be related to mineral deposits (beryllium, fluorine, arsenic, seleni-

um, cadmium, mercury, and lead). The hazard of Hg in power plant emissions, in particular, has been grossly exaggerated. Most elements in coal are very close to their crustal abundance, and are not considered toxic at this level. The question of toxicity must be evaluated in relation to actual amounts. The selection of a completely nonpolluting coal is not possible. For a given amount of ash, coals which are low in any one group of elements must be correspondingly high in others. The definition of nonpolluting depends directly on the decision as to which elements are of concern, and which are not. (Author conclusions modified)

74154

Descroix, P.

EFFECT OF AIR POLLUTION ON WATER POLLUTION IN FRANCE. (L influence de la pollution atmospherique sur la pollution de l eau en France). Text in French. Tech. Sci. Munic. Rev. Eau, 70(3):127-129, March 1975. 4 refs.

Studies and measurements on water pollution caused by air pollution in France are reviewed. Systematic precipitation pH measurements in and around Paris show an increasing acidification of the precipitation during the last years. However, the acid precipitation is readily neutralized in the sewer system and in the rivers. Vanadium, present in coal and petroleum products, is emitted into the air in detectable quantities, but it is readily and rapidly eliminated from water by spontaneous precipitation and flocculation. Wastewater from flue gas scrubbers in phosphoric acid and superphosphate production plants can be contaminated by large concentrations of fluorine, which represents water contamination hazards.

74262

Heimler, Bo

WASTE INCINERATION. ASSESSMENT OF SAVENAS INCINERATOR PLANT WITH RESPECT TO WASTES, FLUE GASES, ASHES, AND SLAG DURING THE JUNE 1973 - MAY 1974 PERIOD. (Avfallsforbranning. En kartering av Savenas Forbranningsanlaggning med avseende pa avfall, rokgas, aska och slagg under tiden Juni 1973 - Maj 1974). Text in Swedish. IVL Swedish Water and Air Pollution Research Laboratory, Stockholm (Sweden), Goteborg Municipal Public Health Board and State Environmental Protection Administration Contract 7-172/72, 46p., Sept. 1974.

Complex assessment of the Savenas waste incinerator plant, Sweden, is presented with respect to the composition of the wastes, flue gas, dust emissions, slag, and water pollution during the June 1973 - May 1974 period. The incinerator temperature ranges from 900 to 1000 C. The flue gases are cooled to about 300 C during heat generation, and pass through an electrostatic precipitator and multicyclone for dust separation, after which they are discharged through a 120-meter high stack. The residual dust concentration in the cleaned gas, standardized for dry gas and 10% carbon dioxide, averages 250 mg/cu m. The specific dust emission amounts to 14 kg/hr per furnace, and to 1.2 kg per ton of waste. The residual dust contains 0.17 mg/kg mercury, 0.82 mg/kg cadmium, 22.2 mg/kg lead, 96.7 mg/kg zinc, 1.6 mg/kg manganese, 1.1 mg/kg copper, 0.8 mg/kg chromium, and 0.42 mg/kg nickel. Some 45-55% of the residual dust was larger than 10 micron, and about 10-15 wt% were in the over 40-micron fraction. The sulfur dioxide plus sulfur trioxide, hydrochloric acid, hydrofluoric acid, oxides of nitrogen, and mercury vapor concentrations in the flue gases averaged 223 mg/cu m, 890 mg/cu m, 7.7 mg/cu m, 29 mg/cu m, 76 mg/cu m, and 383 mg/cu m, respectively.

74512

Suketa, Yasunobu, Shoichi Shimokawa, and Takeo Yamamoto

STUDIES ON ENVIRONMENTAL POLLUTION BY FLUORIDE. II. DETERMINATION OF FLUORIDE IN SOIL. (Fukka butsu ni yoru kankyo osen ni kansuru kenkyu. Dai 2-ho. Dojo chu fusso no teiryo ho no kento). Text in Japanese. Eisei Kagaku (J. Hyg. Chem.), 21(2):89-92, 1975. 20 refs.

The determination of fluorine in soil by a fusion and distillation technique is described along with measurements near an aluminum smelting plant. The final determination of fluoride ion in the distillate was made the Alizarin-Lanthanum complexation or the Thorium Neothorium Method. Sodium carbonate and zinc oxide were used for the fusion of the soil sample, and nearly 100% fluorine recovery was obtained by the fusion of 1:2:3 (weight/weight) mixture of soil sample, sodium carbonate, and zinc oxide, respectively, at a fusion temperature between 600 and 1000 C. The recovery showed good repeatability. The fused material was then suspended with sulfuric acid solution and distilled. If the distillation was made a temperature between 135 and 145 C which gave a sulfate ion concentration less than 100 ppm in the distillate both the Alizarin-Lanthanum Complexation and the Thorium Neotheorium method could be used to determine the fluoride ion in the distillate without interference. Soil samples collected around an aluminum smelting plant showed decreasing fluorine levels at increasing distances from the plant. The fluorine levels were 435 ppm, 322 ppm, and 146 ppm for soil samples collected that 1.5 km, 3.5 km, and 5.0 km, respectively, from the plant.

74586

Danchick, R. S. and J. R. Ryan

CAPTURE AND ANALYSIS OF GASEOUS FLUORIDE EMITTED FROM ALUMINUM REDUCTION CELLS. Aluminium, 51(4):284-288, 1975. 4 refs.

The development of an experimental instrument to monitor both low concentrations of fluoride in effluent gases from the Alcoa 398 fume recovery system and higher concentrations at the inlet of the Alcoa 398 process is described. Gaseous fluoride was removed from the effluent gas sample stream with a unique, continuous aerosol gas scrubber. A fluoride-selective electrode continuously measured the fluoride concentration in the scrubber solution with a permanent record obtained with a strip chart recorder. While testing the efficiency of the Alcoa 398 process, it was found that the gaseous fluoride content of the fluidized alumina bed varied over a large concentration range with time, increasing during crust breaking, anode setting, and metal tapping. The reserve capacity of the Alcoa 398 fume recovery system was able to accommodate large changes in load. Scrubbing efficiencies, the magnitude and duration of the concentration excursions, at the inlet of the Alcoa process, and specific implications for various dry scrubbing fume recovery systems are described.

75077

Greifer, Bernard and John K. Taylor (eds.)

SURVEY OF VARIOUS APPROACHES TO THE CHEMICAL ANALYSIS OF ENVIRONMENTALLY IMPORTANT MATERIALS (FINAL REPORT). National Bureau of Standards, Washington, D. C., Analytical Chemistry Div. Environmental Protection Agency Contract NBS-EPA-IAG 0215(D), Proj. 3105440, Rept. NBSIR 73-209, 237p., July 1973. 587 refs. NTIS: COM-74-10469

Methods for the elemental trace analysis (less than 100 ppm) of mercury, beryllium, cadmium, arsenic, vanadium, manganese, nickel, antimony, chromium, zinc, copper, lead, selenium, boron, fluorine, lithium, silver, tin, iron, strontium, sodium, potassium, calcium, silicon, magnesium, uranium, and thorium in such matrices as fly ash, coal, oil, ores, minerals, metals, alloys, organometallics, incinerator particulates, slurry streams, and feeds to and from sedimentation processes are summarized in terms of capabilities and costs. The methods include: various nuclear techniques such as neutron activation analysis, spark source mass spectrometry, X-ray fluorescence, electron microprobe spectrometry, atomic absorption spectrometry, absorption spectrophotometry, atomic emission spectrometry, voltammetry (polarography), and potentiometry (ion-selective electrodes).

75089

Katari, Vishnu, Gerald Isaacs, and Timothy W. Devitt

TRACE POLLUTANT EMISSIONS FROM THE PROCESSING OF NON-METALLIC ORES (FINAL REPORT). PEDCo Environmental Specialists, Inc., Cincinnati, Ohio, Environmental Protection Agency Contract 68-02-1321, Program Element 1AB015, Task 4, ROAP 21AUZ-02a, Rept. EPA-650/2-74-122, 277p., Nov. 1974. 99 refs. NTIS: PB 240117/AS

Significant sources of emissions of potentially hazardous trace pollutants from the mining and processing of non-metallic minerals are identified. Process flow diagrams identifying major processes and material flow as well as pollutant emission sources are provided for operations dealing with cement, clay (including porcelain, refractory, and brick), gypsum, lime, phosphate rock (including fertilizer), potash, boron, mica, and fluorspar. The following processes are recommended for further evaluation because of their potential for emissions of hazardous pollutants or fugitive dust: cement and lime kilns, phosphate rock mining and washing, clay mining, and wet-process as well as thermal phosphoric acid production. Pollutants identified included: fluorides, phosphoric acid mist, carbon dioxide, various metal compounds, fly ash, sulfur dioxide, sulfur trioxide, sulfates, and alkali chlorides.

75146

King, W. R. and J. K. Ferrell

FLUORIDE EMISSIONS FROM PHOSPHORIC ACID PLANT GYPSUM PONDS (FINAL REPORT). North Carolina State Univ., Raleigh, Environmental Protection Agency Grant R-800950, Program Element 1AB015, ROAP 21AFA-075, Rept. EPA-650/2-74-095, 323p., Oct. 1974. 29 refs. NTIS: PB 241144/AS

Fluoride emissions from gypsum ponds receiving process water from wet-process phosphoric acid plants were measured, and computer simulations of pond emissions and ambient air concentrations were developed. Measured ambient air fluorine concentrations for 95 usable samples obtained at two pond sites ranged from 00000015 to 00000415 moles/cu m. Emission estimates developed from the pond-to-air mass transfer coefficient and the vapor pressure of fluorine over pond water were used along with a standard atmospheric pollutant dispersion model to predict ambient fluorine concentrations. A comparison of the predicted fluorine values with measured fluorine values demonstrated the validity of the emission estimates.

75206

Office of Air and Waste Management, Research Triangle Park, N. C., Emission Measurement Branch

AIR POLLUTION EMISSION TEST. COLORADO FUEL AND IRON. Rept. 75-SIN-5, 71p., Feb. 1976. 4 refs.

Emissions tests were performed at the outlet of an electrostatic precipitator serving the Colorado Fuel and Iron Steel Corporation sintering process in Pueblo, Colorado to obtain data for the development of New Source Performance Standards. The particulate emission rate averaged 174.2 kg/hr, and the process basis emission rate was 0.481 kg/million tons of feed. The average fluoride emission rate was 3.85 kg/hr. Very few of the 6-minute average opacity readings were greater than 20%. High readings at the precipitator outlet were noted, however, following periodic rapping of the collecting plates.

76122

Loch, Thomas A.

AIR POLLUTION EMISSION TEST. SINTER PLANT GRANITE CITY STEEL DIVISION NATIONAL STEEL CORPORATION GRANITE CITY, ILLINOIS (VOLUMES I AND II). Clayton Environmental Consultants, Inc., Southfield, Mich. and York Research Corp., Stamford, Conn., Environmental Protection Agency Contracts 68-02-1406 and 68-02-1401, Tasks 16 and 19, Rept. 75SIN4, Y-84-19, 151p., 1975. 2 refs.

The emissions from the Granite City Steel sintering facility at Granite City, Illinois were documented. The efficiency of the high energy venturi scrubber used to control emissions was tested. Particulate, fluoride, hydrocarbon, sulfur oxides, and carbon monoxide were sampled. A trend in opacity decrease occurs as measured total particulate concentrations decrease. Particle size tests were also performed at the inlet and outlet of the scrubber. A majority of the incoming particles, 52.9%, are less than 1.0 micron in size and of the total particulate entering the scrubber, 30.6% is above 6.7 micron in size. At the outlet, 93.7% of the particles are below 1.0 micron in size and 1.8% of the particles are above 6.8 micron in size. The average inlet and outlet particulate concentrations were 0.1599 g/SCFD and 0.01673 g/SCFD, respectively. The inlet concentration ranged from 0.1065 g/SCFD to 0.1887 g/SCFD, while the outlet varied from 0.01673 to 0.01720. (Author abstract modified)

76152

Baladi, Emile

AIR POLLUTION EMISSION TEST. BEKER INDUSTRIES, INC. Midwest Research Inst., Kansas City, Mo., Office of Air and Waste Management Contract 68-02-1403, Proj. 3927-C(13), Rept. 75-PRP-4, 83p., Nov. 19, 1975. 3 refs.

Particulate emissions tests were performed at the baghouse of a ball mill and the venturi scrubber of a calciner serving the Beker Industries, Incorporated phosphate rock processing operation at Conda, Idaho to obtain data for the development of New Source Performance Standards. The average particulate load value at the outlet of the baghouse was 0.00218 grains/dry standard cu ft, and the average particulate removal efficiency of the baghouse was 99.96%. The average particulate load value at the outlet of the scrubber was 0.04651 grains/dry standard cu ft. Fluoride emissions from the facility averaged 0.058 kg/hr. The average percent opacity was 0.0 at both the calciner s scrubber and the ball mill s baghouse outlet. Particle size distribution data were also obtained.

76190

Bryan, Robert J.

AIR POLLUTION EMISSION TEST. KAISER STEEL CORPORATION. Pacific Environmental Services, Inc., Santa Monica, Calif., Office of Air and Waste Management Contract 68-02-1405, Task 6, Rept. 75-SIN-3, 33p., Nov. 19, 1975. 2 refs.

Particulate and fluoride emissions tests were performed on the outlet of a baghouse serving the iron ore sintering operation of the Kaiser Steel Corporation located in Fontana, California to obtain data for the development of New Source Performance Standards. The sintering plant agglomerates ore fines and flue dust to a product acceptable for charging into a blast furnace. The average particulate grain loading was 0.0578 grains/standard cu ft, and the average fluoride grain loading was 0.00015 grains/standard cu ft.

76274

Kumamoto Prefectural Government (Japan)

AUTOMOBILE EMISSION GAS. (Jidosha haishutsu gasu). Text in Japanese. In: Environmental White Paper in 1974, p. 34-54, June 1975.

Data on automotive exhaust emissions, concentrations of carbon monoxide, nitrogen dioxide, hydrocarbons, oxidant, and particulates, traffic volume, meteorological factors and the results of particulate composition measured at eight busy intersections in three cities in Kumamoto during 1973 were compiled and analyzed. A comparison to 1972 data indicates that pollutant concentrations have generally increased; however, the air pollution problems due to automotive exhaust emissions were not greatly aggravated. Data concerning the registration of flue gas emission sources in compliance with the regulation are compiled and classified by the type of facilities. Air pollution control measures taken in Kumamoto are discussed, and a description of the monitoring system for sedimented dust, sulfur oxides, suspended particulates, and fluorine, and the air pollution emergency procedures are given, with maps of measurement points.

76411

Bekturov, A. B., G. N. Breusova, and V. K. Esik

PHYSICO-CHEMICAL INVESTIGATION OF DUST GENERATED IN DEFLUORINATED PHOSPHATE PRODUCTION FROM KARATAU PHOSPHORITES. (Fiziko-khimicheskie issledovaniya pyley, obrazuyushchikhsya pri proizvodstve obesftorennogo fosfata iz fosforitov (Karatu). Text in Russian. Izv. Akad. Nauk Kaz. SSR, Ser. Khim., no. 3:1-5, May-June 1975. 6 refs.

The behavior of dusts separated in electrostatic precipitators in the defluorinated phosphate production from Karatau phosphorites during heating in the 100-1300 C temperature range was studied under laboratory conditions. Heating in the 100-700 C temperature interval caused weight losses ranging from 1 to 13%, depending on the chemical composition of the dust. About 30 to 70% of the fluorine was liberated at temperatures of up to 600 C due to the decomposition of the fluorosilicates. A further increase of the temperature to 1300 C led to an increase in the defluorination rate to 70-95% only in the presence of water vapor. At temperatures over 900 C, potassium compounds volatilized at a rate of 40-60%, while other alkali metal compounds were not affected.

76459

King, William R. and James K. Ferrell

WET PROCESS ACID PLANT WASTEWATER PONDS, AN ATMOSPHERIC FLUORIDE POLLUTION PROBLEM? Preprint, FMC Corp., Philadelphia, Pa., and North State Univ., Raleigh, N. C., 18p., July 1975. 7 refs.

A method for estimating the volatile fluorine emissions from phosphoric acid plant waste water ponds was developed and verified by actual downwind measurements. Fluorine emission rates for two actual ponds were estimated from a knowledge of the fluorine concentration and water temperature of the ponds and atmospheric conditions at the ponds. These emission estimates were then entered into a standard atmospheric dispersion model which predicted ambient air fluorine concentrations downwind of the two ponds. None of the estimates were significantly different from the measured values at the 95% confidence level.

76638

Kautz, K., H. Kirsch, and D. W. Laufhuette

TRACE ELEMENT CONTENT IN SOFT COALS AND IN THEIR DUSTS. (Ueber Spurenelementgehalte in Steinkohlen und den daraus entstehenden Reingasstaeuben). Text in German. VGB Kraftwerkstechnik, 55(10):672-676, Oct. 1975.

Twenty-six different coals and dust samples emitted during their combustion were analyzed for 26 elements. The silver, beryllium, bismuth, cadmium, mercury, iodine, tin, selenium, tellurium, tantalum, and tungsten contents in anhydrous coal were below 10 ppm, while the contents of another 7 elements (arsenic, boron, cobalt, chromium, copper, molybdenum, and nickel) were below 100 ppm, averaging below 50 ppm. The barium, fluorine, phosphorus, lead, strontium, vanadium, and zinc contents were between 50 ppm and 400 ppm. The silver, beryllium, bismuth, cadmium, mercury, iodine, thallium, tantalum, uranium and tungsten contents in the emitted dust were below 50 ppm, and the arsenic, boron, cobalt, copper, molybdenum, tin, and selenium contents averaged between 100 and 500 ppm. The barium, chromium, fluorine, nickel, phosphorus, lead, strontium, vanadium, and zinc contents were between 500 and 3000 ppm. Phosphorus contents of up to 14,000 ppm were measured.

76644

Gratz, Reinhard

FLUORIDE IN CERAMIC MATERIALS AND FUELS--MATERIAL MEASURES FOR PREVENTION OF FLUORIDE EMISSIONS (FINAL REPORT). (Fluor in keramischen Materialien und in Brennstoffen. Stoffliche Massnahmen zur Vermeidung von Fluor-Emissionen). (Schluss). Text in German. Ziegelind. (Weisbaden), (5):210-216, 1974.

Fluoride emissions from the big ceramics industry are described, and prevention methods of fluoride emissions are discussed. After describing the properties of fluoride and its compounds, the effect of fluoride emissions is analyzed. After presenting measurement methods for fluoride emissions, the emissions in the earthenware industry are described. Fluoride appears in ceramics raw materials in various quantities, depending upon the quality of the minerals and the properties of the compounds. The alloys used and the quality of the fuel also significantly influence the fluoride emissions. The type of ovens and chimneys also play an important role, including oven atmosphere, duration of combustion, and combustion temperature. Recommendations are made based on literature and the research results of the Institute for Bricks Research for decrease of fluoride emissions. They concern fuel quantity,

oven atmosphere, and chimney gas atmosphere. Some measures are opposed to requirements of optimal combustion. Measurement methods for fluoride emissions are described.

77367

Smidt, H.

GAS AND DUST EMISSIONS FROM SUGAR FACTORIES - TECHNICAL POSSIBILITIES OF REDUCING EMISSIONS WITH REFERENCE TO LOCAL AUTHORITY REGULATIONS. (Ges-und Staubemissionen von Zuckerfabriken - Technische Moeglichkeiten zur Emissionsmidnerung unter Beruecksichtigung der behoerdlichen Vorschriften). Text in German. Zucker, 28(9):491-498, Sept. 1975.

Emissions from sugar factories are grouped under gaseous and dust-type emissions. Main emission sources are the boiler plant and pulp dryer. The various levels and causes of dust emissions from solid fuel and oil firing are described. Gaseous emissions include sulfur oxides, nitrogen oxides, fluorine, and to a certain extent, hydrocarbons (odor emissions). Noxious gaseous emissions are indicated for a model factory with a beet-slicing capacity of 5000 tons/day. The effect of fuel, type of firing and operation is demonstrated. The technical possibilities of reducing emissions are tied up with legal requirements. Gaseous emissions cannot in practice be reduced by technical processes. Suitably high stacks must be erected for the distribution of emissions. With regard to sulfur dioxide, improvements can be made by fuel desulfurization. Dust emissions from pulp drying can be kept within reasonable limits by multi-cyclones.

77522

Tochigi Research Inst. for Environmental Pollution (Japan), Dept. of Air Quality and Noise

FLUE GAS INVESTIGATION. (Endo haishutsu gasu no chosa ni tsuite). Text in Japanese. Tochigi-ken Kogai Kenkyusho Nenpo (Annu. Rep. Tochigi Prefect. Res. Inst. Environ. Pollut.), no. 1:91, Jan. 1975.

The flue gas pollution by 109 facilities at 100 factories were investigated and three years of measurement results from 1971 through 1973 summarized for the flue gas emission rate, amount of soot, sulfur oxides, fluoride, chloride, hydrogen chloride, and nitrogen oxides pollutions. The facilities included were 36 boilers, 3 heating furnaces, 20 dissolution furnaces, 16 driers, 26 sintering furnaces, and 8 others. Of the facilities investigated 35.8% (29 facilities) violated the air pollution standards either on the amount of soot or SOx. In the facilities for driers, only one was within the standards and 15 were in violation. Of 36 boilers, 5 boilers exceeded the standards and 31 boilers were within the standards.

77993

King, William R. and James K. Ferrell

FLUORINE EMISSIONS FROM WET PROCESS PHOSPHORIC ACID PLANT PROCESS WATER PONDS. Preprint, Air Pollution Control Assoc., Pittsburgh, Pa., 17p., 1975. 8 refs. (Presented at the Air Pollution Control Association, Annual Meeting, 68th, Boston, Mass., June 15-20, 1975, Paper 75-25.7.)

Emission estimates for the release of volatile fluorine compounds from process water ponds at phosphate fertilizer plants were developed from the pond-to-air mass transfer coefficient and the vapor pressure of fluorine over pond water. The estimates were compared with measurements of ambient fluorine compound concentrations downwind of process water ponds and the estimates were found to be valid. Emissions from the ponds ranged from 0.7 to 10 lb/acre/day. The emission rate depended on pond temperature, fluorine content of the pond water, and wind speed. (Author abstract modified)

79043

Kalmon, B. and F. A. Koehler

PORTSMOUTH GASEOUS DIFFUSION PLANT ENVIRONMENTAL MONITORING REPORT-1973. Goodyear Atomic Corp., Piketon, Ohio, Atomic Energy Commission Contract AT-(33-2)-1, 27p., May 3, 1974. 5 refs. NTIS: GAT-781

Emissions measurements and ambient air monitoring data for the Portsmouth Gaseous Diffusion Plant are presented. The average environmental concentrations of alpha and beta activity at those locations where the averages were the highest were 0.63% and 0.08%, respectively, of the Atomic Energy Commission s Radioactivity Concentration Guides. The highest single ambient sulfur dioxide concentration was 15% of the Federal standard. Sulfur dioxide emissions from a steam plant burning low and high sulfur coal were 1 lb/million Btu input and 3 lb/million Btu input, respectively. Particulate matter emissions for low and high sulfur coal were 0.4 and 0.2 lb/million Btu input, respectively. Ambient fluoride concentrations in the vicinity of the plant reached a maximum of 5.1 ppb. The overall yearly average of fluoride concentrations in vegetation around the plant boundaries was 6.5 micrograms/g. With the exception of particulate matter, none of the emission levels or ambient concentrations exceeded applicable standards during 1973.

79280

Polhemus, John

RUBBER, PLASTICS AND GLASS INDUSTRIES ODORS. In: Industrial Odor Technology Assessment. Paul N. Cheremisinoff and Richard A. Young (eds.), Ann Arbor, Mich., Ann Arbor Science Publishers, Inc., 1974 (?), Chapt. 8, p. 101-115. 41 refs.

Odor problems associated with rubber, plastics, and glass industries are reviewed. Odors from the rubber and plastics industry commonly fall into the following groups: nitro compounds (amines and oxides), sulfur oxides, plasticizers, solvents, and phenols, and other alcohols). Operations in the rubber and plastics industry which generate odors include: compounding and formulation, material handling, banbury, mills, curing and vulcanizing, and forming (extruders and presses). Glass industry odors are usually associated with furnace products, mold lubrication maintenance, and coating operations. The odorous emissions include: sulfur oxides, nitrogen oxides, and halide gases. Odors generated by support operations in the glass industry include hydrofluoric acid which is used for glass etching and aromatics which are used as carriers in Teflon coating.

79511

Fraszczak, Krystyna and Krzysztof Wojcik

FLUORINE COMPOUNDS IN A SULFUR-PRODUCING INDUSTRIAL REGION. (Zwiazki fluoru w powietrzu atmosferycznym w rejonie zaglebia siarkowego). Text in Polish. Ochrona Powietrza (Warsaw), no. 3:91-92, 1975.

Volatile fluorine compounds have a toxic effect on live organisms and constitute a serious problem in sulfur-producing regions because they frequently exceed permissible concentrations. They are emitted by plants manufacturing powderized and granular superphosphates. These fluorine gases are hydrogen fluoride (HF) and silicon tetrafluoride (SiF4), which cause a serious irritation of the upper respiratory tract. Chronic intoxication at low concentrations is probably due to the highly toxic fluorine ion (F-). Fluorine and its compounds

emitted with industrial waste gases can lead to fogs resulting in mass poisoning in an industrial area during adverse atmospheric conditions. Systematic investigations of atmospheric volatile fluorine compounds are therefore necessary. A method is described by which, based on collected annual data, the frequency of excessive permissible 20-min and average daily concentrations over an area of 280 sq km was statistically calculated. The former, higher than permissible concentration (0.03 mg/F/cu m) should not occur more than once a day, the latter (standard 0.01 mg F/cu m) concentration once every 10 days over a period of one year, which corresponds to 1.4% and 10%, respectively. Determination of the fluorine ion content was performed colorimetrically with alizarin and lantan nitrate. The intensity of the color change in the solution from red to blue is proportionate to the fluorine concentration. The status of air pollution with fluorine compounds for 1972 and 1973 was established and the role of wind direction in the spread of pollution was taken into consideration for the hours of the sample taking. Evaluation of the environmental danger level led to a successful program of limiting fluorine compound emissions.

79567

Naughton, J. J. V. Lewis, D. Thomas, and J. B. Finlayson

FUME COMPOSITIONS FOUND AT VARIOUS STAGES OF ACTIVITY AT KILAUEA VOLCANO, HAWAII. J. Geophys. Res., 80(21):2963-2966, July 20, 1975. 22 refs.

The particulate and gaseous composition of the fume cloud as it issued from an erupting volcanic vent at Mauna Ulu on the east rift zone of Kilauea Volcano, Hawaii was investigated. Similar measurements were made at Halemaumau, the summit crater of Kilauea, during non-eruptive periods from nearby fissures erupting on the floor of Kilauea caldera. Fume was collected at Kilauea Volcano with equipment patterned after that used in industrial pollution studies. The chief components are sulfur dioxide, sulfur tetraoxide, chlorine, sodium, calcium, potassium, fluorine, magnesium, and iron in that order of decreasing concentration. Content and order of abundance vary depending on the state of activity of the volcanic sources of the fume. Sulfur compounds are preponderant. (Author abstract modified)

79774

Wilson, Hugh H. and Larry D. Johnson

CHARACTERIZATION OF AIR POLLUTANTS EMITTED FROM BRICK PLANT KILNS. Am. Ceram. Soc. Bull., 54(11):990-991, 994, Nov. 1975. 10 refs.

The characterization of air pollutants emitted from four brick plant kilns was determined. The emissions vary considerably from plant to plant. The chemical and mineral composition of brick clays and the firing temperatures are widely different from one plant to another. The pollutant concentrations vary because of the different combustion conditions that exist among the plants. Fine particulates, fluorine, and sulfur gases are the pollutants that are most likely to require control in brick manufacturing. In the four plants studied, only sulfur dioxide values at one plant are high enough to cause possible concern as a pollution source.

80238

Gnyp, A. W., S. J. W. Price, C. C. St. Pierre, and B. Chongpison

AN INFORMATION SEARCH AND EVALUATION OF PROPERTIES, POTENTIAL SOURCES, LEVELS OF ATMOSPHERIC EMISSIONS AND ENVIRONMENTAL EFFECTS OF EXOTIC AIR POLLUTANTS. Preprint, Windsor Univ., Windsor (Canada), Industrial Research Inst., 383p., 1973. 26 refs.

The properties, potential sources, levels of atmospheric emissions, and environmental effects of major exotic air pollutants are summarized. Environmental air standards, detection and measurement, and abatement methods are also discussed. Data are provided on ammonia, arsenic, asbestos, barium, beryllium, boron, cadmium, chlorine, chromium, copper, fluorine, hydrocarbons, hydrochloric acid, hydrogen sulfide, iron, lead, manganese, mercury, nickel, phosphorus, selenium, vanadium, and zinc. (Author abstract modified)

80334

ECOLOGICAL DIAGNOSIS FOR THE PROVINCE OF EMIGLIA ROMAGNA. (Diagnosi ecologica per l Emilia Romagna). Text in Italian. Notizie, no. 175:30-39, April 1974.

The main sources of pollution in Emiglia Romagna were divided into 5 broad categories: population, animal rearing, agriculture, industry, and motor vehicles. The distribution of the pollutants particular to each group were analyzed for 341 municipalities. Organic pollution was principally a problem in the area of rivers: the Po, the Po of Volano, and the Rhine. Control procedures for industrial and municipal water pollution are discussed. Sulfur dioxide was the most widespread air pollutant; 57% due to industrial emissions; 28% due to hydroelectric power plants; and 13.5% due to heating. Other emission sources are reviewed: industry is responsible for 81% of dust emissions and 100% of fluoride emissions; motor vehicles account for 92% of carbon monoxide, 80% of lead, and 60% of hydrocarbon emissions. Recovery of materials from solid wastes may be practical, because of the large volume of such wastes.

80507

Berge, Helmut, Erwin King, and Dieter Lorenz

WATER VAPOR IMMISSIONS IN THE AREA OF A CONVENTIONAL THERMAL POWER PLANT. (Wasserdampfimmissionen im Bereich eines koventionellen thermischen Kraftwerks). Text in German. VDI (Ver. Deut. Ingr.) Z. (Duesseldorf), 117(15/16):721, 1975. (Full text available from VDI-Verlag GmbH, 4 Duesseldorf 1, Postfach 11 39, West Germany.)

Meteorological, agrochemical, and air pollution studies around a conventional thermal power plant with cooling towers in the July 1972 through June 1974 period in the Koeln area in West Germany are summarized. The solar radiation losses due to the cooling towers ranged from 5 to 25% within a 500 m radius, and between 1% and 5% at distances between 500 m and 1000 m. The haze emitted by the cooling towers appears to cause a slight increase in the precipitation in the immediate vicinity, while the waste heat emission caused a slight temperature increase and a reduction of the relative humidity on the lee side. Systematic measurements of fluorine concentrations revealed frequently high concentrations in 1973, sometimes in excess of the 4 microgram/cu m limit, and substantially lower concentrations in 1974. The findings indicate a relatively high background concentration rather than a relationship between the power plant and the fluorine levels.

80994

Kirsch, H.

COMPOSITION OF DUST IN THE WASTE GASES OF INCINERATION PLANTS. VGB Technische Vereinigung der Grosskraftwerksbetreiber e. V., Essen (West Germany), Con-

vers. Refuse Energy Int. Conf. Tech. Exhib., 1st, Montreux, Switzerland, 1975, p. 185-189, (Nov. 3-5.)

The composition of dust in the waste gases of seven incineration plants was analyzed. Thirty-five chemical elements were analyzed quantitatively. Apart from the normal elements, silicon, aluminum, calcium, potassium, sodium, iron, and sulfur, the samples contained lead, zinc, and chlorine with concentrations above 2% by weight. The average content of barium, copper, fluorine, and tin was above 500 ppm. There were huge differences in chemical composition from one plant to another. The concentration of mercury varied within the samples from 1-800 ppm.

81169

Brakhnova, I. T. and S. A. Mosendz

COMPARATIVE HEALTH ASSESSMENT OF POWDER-FILLED WIRES EMPLOYED FOR SURFACING. Weld. Prod., 22(2):78-80, 1975. 5 refs.

The gross emissions of dust and gases formed during surfacing with the powder filled wires used in the welding industry were determined for PP-AN-124, PP-AN-125, PP-AN-G13N4, and PP-AN-170. Fluorides, carbon monoxide, oxides of nitrogen, and ozone form during surfacing with all wires. Dust emission is greatest when surfacing with PP-AN-124. The highest emission of fluoride occurs in surfacing with PP-AN-G13N4. Large quantities of CO form especially with PP-AN-124 and PP-AN-G13N4. Up to 60% of the aerosol component is in the form of carbides of manganese, iron, silicon, and chromium. Changes in the choline esterase activity in the liver and kidney are most pronounced in animals under the action of aerosols from surfacing wires PP-AN-G13N4 and PP-AN-124. Wire grades PP-AN-125 and PN-AN-170 have the least health hazards.

81343

Kautz, K., H. Kirsch, and D. W. Laufhuette

TRACE ELEMENT CONCENTRATIONS IN HARD COAL AND CLEANED GAS DUSTS DEVELOPING FROM IT. (Ueber Spurenelementgehalte in Steinkohlen und den daraus entstehenden Reingasstaeuben). Text in German. VGB Kraftwerkstechnik, 55(10):672-676, 1975.

Twenty-seven hard coal samples of different origin, and 20 dust samples collected after electrostatic precipitators in power plants firing these coal were analyzed for their trace element contents. A comparison of the trace element concentrations in coal ashes, coal, and dust revealed that correlations between the concentrations in the coal or ashes and in the dust do not exist necessarily. The mercury and iodine concentrations in the dust samples were usually lower than in the coal as a result of volatilization during the combustion process. The boron, barium, bismuth, cadmium, cobalt, copper, molybdenum, nickel, titanium, vanadium and tungsten concentrations were about the same in the coal, ashes, and dust samples, while the arsenic, beryllium, chromium, fluorine, phosphorus, and tellurium concentrations were higher in dust than in ashes or coal by 2 to 3 times. The silver, lead, tin, selenium, strontium, uranium, and zinc concentrations were usually up to 10 times higher in dust than in ashes.

81745

Saito, Koichi and Tatsuya Saijo

ON THE TOXIC GAS INVESTIGATION AT THE STATIONARY SOURCE. (Hasseigen ni okeru yudoku gasu no chosa). Text in Japanese. Ibaragi-ken Kogaigijutsu Senta Nenpo (Annu. Rept. Environ. Pollut. Res. Center Ibaragi Pref.), no. 7:44-48, Oct. 1975.

A survey on hydrogen fluoride, hydrochloric acid, chlorine, and sulfur oxides emissions from 8 facilities, and nitrogen oxides emissions from 29 facilities in Ibaragi Prefecture is reported. All determinations were based on the Japan Industrial Standard Method. High HF emissions were expected from glass manufacturers; however, their emissions were below the standard (at about 1.59 ppm). More than 90% desulfurization was achieved for the flue gases from cement calculation furnaces. Chlorine gas emissions were very small, reflecting the control effort made by the facilities; the highest level found was 1.8 ppm from a copper dissolution furnace. The HCl emissions depended on the type of facilities; municipal refuse incinerators had poor HCl control, and one such facility indicated 13.0 ppm HCl. The NOx emission tended to be higher for larger scale facilities. Those facilities having large boilers showed high levels of NOx emission, which suggested the necessity for thermal NOx control. The NOx level from these facilities was up to 326 ppm.

81861

Boldt, Karl R.

AIR POLLUTION EMISSION TEST. BETHLEHEM STEEL CORP (FINAL REPORT). York Research Corp., Stanford, Conn., Office of Air and Waste Management Contract 68-02-1401, Task 18, Rept. 75-SIN-1, Y-8479-18, 116p., Dec. 22, 1975. 2 refs.

Emissions tests were performed at the inlet and outlet of an electrostatic precipitator and the outlet of a baghouse located at Bethlehem Steel Corporation s sintering plant in Bethlehem, Pennsylvania. The tests were performed as part of an Environmental Protection Agency effort to develop performance standards for new sintering operations. Average particulate loadings at the precipitator inlet and outlet were 0.2865 grains/standard cu ft and 0.0301 grains/standard cu ft, respectively. Particulate emissions at the baghouse outlet averaged 0.0153 grains/standard cu ft. Average opacities at the precipitator and baghouse stacks were 4% and 1%, respectively. Emission rates at the precipitator outlet for condensible hydrocarbons, non-condensible hydrocarbons, fluoride, carbon monoxide, sulfur dioxide, sulfur trioxide, and nitrogen oxides were 0.778, 609, 2.46, 6837, 1791.3, 28.5, and 102.2 lb/hr, respectively. (Author summary modified)

81916

Kalmon, B.

PORTSMOUTH GASEOUS DIFFUSION PLANT ENVIRONMENTAL MONITORING REPORT - 1974. In: Environmental Monitoring at Major U. S. Energy Research and Development Administration Contractor Sites. Vol. 2, Energy Research and Development Administration, Washington, D. C., Rept. GAT-824, p. 1035-1064, 1975. 3 refs. NTIS: ERDA-54

Environmental monitoring data for the Portsmouth Gaseous Diffusion Plant are presented. The principal process in the plant is the separation of uranium isotopes through gaseous diffusion. The highest single ambient sulfur dioxide concentration measured in the plant s vicinity was 12% of the most recent federal standard, and the average values were less than 3% of the standard. The highest fluoride concentration measured near the plant was 2.65 micrograms/cu m. Sulfur dioxide emissions during the burning of low sulfur coal were slightly less than 1 lb/million Btu, and SO2 emissions during the burning of high sulfur coal amounted to slightly over 3 lb/million Btu. Particulate matter emissions amounted to 0.4 and 0.2 lb/million Btu for low and high sulfur coal, respectively.

81917

Union Carbide Corp., Oak Ridge, Tenn., Office of Safety and Environmental Protection

ENVIRONMENTAL MONITORING REPORT. UNITED STATES ENERGY RESEARCH AND DEVELOPMENT ADMINISTRATION. PADUCAH GASEOUS DIFFUSION PLANT. CALENDAR YEAR 1974. In: Environmental Monitoring at Major U. S. Energy Research and Development Administration Contractor Sites. Vol. 2, Energy Research and Development Administration, Washington, D. C., Rept. UCC-ND-303, p. 1003-1033, 1975. 5 refs. NTIS: ERDA-54

Environmental monitoring data obtained in the vicinity of the Paducah Gaseous Diffusion Plant are presented. The plant operations are involved with uranium enrichment and with uranium hexafluoride manufacturing. A steam plant on the grounds burned gas and oil during 1974 and was in compliance with the Kentucky air pollution control regulations for particulates and sulfur oxides. An indicator was taken out of operation during the third quarter of 1974 because visible emissions appeared to violate Kentucky regulations. The incinerator is schedule for return to service when repairs to its off gas scrubber are complete. Ambient fluoride concentrations in the vicinity of the Paducah installation ranged from less than 0.11 to 4.56 ppm (as hydrogen fluoride) during 1974.

81931

ANNUAL ENVIRONMENTAL REPORT 1974. DUQUESNE LIGHT COMPANY. BEAVER VALLEY POWER STATION AND SHIPPINGPORT ATOMIC POWER STATION. In: Environmental Monitoring at Major U. S. Energy Research and Development Administration Contractor Sites. Vol. 1, Energy Research and Development Administration, Washington, D. C., p. 685-790, 1975. 3 refs. NTIS: ERDA-54

Environmental monitoring operations involving the sampling of airborne emissions and the measurement of ambient air pollution levels at the Duquesne Light Company s Beaver Valley power station and Shippingport atomic power station are reviewed. A total of 26,530 cu ft of gas was released from the Shippingport station s vent gas system with a total radioactive activity of less than 0.001 curies. There were no other forms of airborne releases at the Shippingport station during 1974. The Beaver Valley power station was not in operation during 1974, and no airborne releases were made during the reporting period. Dust fall measurements made in 1972 at a distance of about 1.5 mi upstream of the Beaver Valley and Shippingport sites indicated that the yearly total dust fall averaged 12 tons/sq mi. The annual arithmetic mean sulfur dioxide level during this period was 0.013 ppm. Other pollutants identified at this upwind site included: fluorides, nitrates, sulfates, manganese, nickel, calcium, zinc, chromium, iron, lead, arsenic, cadmium, vanadium, and beryllium.

81935

Union Carbide Corp., Oak Ridge, Tenn., Office of Safety and Environmental Protection

ENVIRONMENTAL MONITORING REPORT. UNITED STATES ENERGY RESEARCH AND DEVELOPMENT ADMINISTRATION OAK RIDGE FACILITIES. CALENDAR YEAR 1974. In: Environmental Monitoring at Major U. S. Energy Research and Development Administration Contractor Sites. Vol. 2, Energy Research and Development Administration, Washington, D. C., Rept. UCC-ND-302, p. 945-1001, 1975. 34 refs. NTIS: ERDA-54

Environmental monitoring data obtained at the Energy Research and Development Administrations Oak Ridge facilities are reported. The average airborne concentrations of particulates and sulfur dioxide were in compliance with applicable standards during 1974, although fluoride concentrations exceeded the standards on several occasions. Annual average fluoride concentrations ranged from 0.9-1.3 ppm. The average particulate concentrations ranged from 40.9-47.8 microgram/cu m, and the annual arithmetic mean sulfur dioxide concentration was 0.013 ppm. Steam plant operations were in compliance with state emission limits except for the steam plant at the Oak Ridge Gaseous Diffusion Plant. Between 0.8 and 1.0 lb/million Btu of particulate emissions were released when coal was burned, and the gaseous effluent from this facility exceeded the 1.60 lb SO2/million Btu by 0.04 lb when 1.1% sulfur coal was burned.

82192

WASTE WATER INCINERATION. (Abwasserverbrennung). Text in German. Chem. Ind. (Duesseldorf), 27(6):319-320, 1975.

General technical and environmental aspects of wastewater incineration are described. Wastewaters with a minimum calorific value of 450-700 kcal/kg or with a minimum organic matter content of 10% are primarily suitable for incineration. The construction of incinerators without emission control devices can be authorized if the organic carbon, carbon monoxide, hydrochloric acid, hydrofluoric acid, sulfur dioxide, nitrogen oxides and dust emissions are expected to be below the maximum allowable values envisaged in the Technical Guidelines on Clean Air Maintenance. Otherwise, dust, CHl, and SO2 emissions can be controlled relatively easily, while the removal of aerosols, formed at temperatures of 850 C and over, is problematic. Electrostatic precipitation, cyclone separation, wet scrubbing, and dry gas cleaning can be considered. Wetted tissue filters operating at 95-99% at pressure losses of 200-400 mm water column are best for this purpose. However, they require flue gas cooling to 100-130 C.

82269

Fukuzaki, Norio and Ryuichi Sugai

MEASUREMENTS OF PARTICULATE FLUORIDES IN NIIGATA PREFECTURE; CHEMICAL COMPOSITION. (Niigata-kenka ni okeru ryushijo fukkabutsu chosa, funjin no seseibunseki). Text in Japanese. Taiki Oseu Kenkyu (J. Japan. Soc. Air Pollution), 10(4):339, 1975. (Presented at the National Air Pollution Research Conference, 16th, Niigata, Nov. 5-7, 1975, Paper 83.)

The chemical composition analysis of airborne dust collected at aluminum refining plants, phosphatic fertilizer plants, and stainless steel plants was done by the X-ray diffraction technique. The sample dust was collected on a millipore filter, or the adsorbed dust within chimneys was collected for analysis. Most of the particle fluorides emitted from aluminum refining factories were sodium aluminum fluoride. Aluminum hexafluorosilicate was not removed by a cleaning tower at the phosphatic fertilizer manufacturer and emitted as the main component of its dust. No particle fluoride could be detected from the stainless steel manufacturer, and ammonium chloride was the major component of its dust.

82279

Wellard, H. J.

WELDING FUME -- ITS CAUSE, EVALUATION AND CONTROL. Welder, 40(199):5-7, 1974. 4 refs.

The protection of workers from fumes likely to be injurious to health is required by law. Welding fumes can be caused by the heating of rods and fluxes or from the effect of the flame, arc, or radiation on the surrounding air or shielding gas or from coatings on the base metal. The present limit is 10 mg/cu m for iron oxide and for inert particles. It is possible from measurements of the rate of fume emission to estimate the volume of fresh air which must be introduced in order that the concentration of fume will not exceed 10 mg/cu m or any lower value required for a particular operation. Various types of welding can also produce ozone, nitric oxide, or nitrogen dioxide. Fume usually contains iron, manganese, oxides, and silicates, and may contain fluorides, chromium, and nickel. Particulate fume from welding of copper base alloys contains typically 40 to 60% copper. Welding accessories for the removal of fumes or protection against their effects are discussed.

82353

Yanaka, Takaaki

INVESTIGATION ON EMISSION GAS AND ATMOSPHERIC FLUORIDE IN NIIGATA PREFECTURE. (Niigata kenka ni okeru haigasu oyobi taikichu no fukkabutsu chosa). Text in Japanese. Taiki Osen Kenkyu (J. Japan. Soc. Air Pollution), 10(4):235, 1975. (Presented at the National Air Pollution Research Conference, 16th, Niigata, Nov. 5-7, 1975.)

The fluoride in the waste gases from aluminum refineries and phosphatic fertilizer manufacturers was analyzed. The analysis was made for both gaseous fluorides and particulate fluorides by trapping with an alkaline filter paper and millipore filter respectively. Detection was by the ion electrode method, after the dissolution of the trapped fluorides. The total fluoride emission ranged from 43 to 568 kg F/cu m, and the particulate fluorides were represented more than the gaseous fluorides, ranging from 41 to 540 kg F/cu m. Fifty to 90% of the particulate fluorides were less than 1 micron in diameter. The particle size distribution curve did not follow the logarithmic normal distribution curve.

82944

Itai, Kazuyoshi

ATMOSPHERIC CONCENTRATION OF FLUORIDE COMPOUNDS IN VARIOUS PLACES. (Honpo kakuchi no taikichu fukkabutsu nodo ni tsuite). Text in Japanese. Taiki Osen Kenkyu (J. Japan. Soc. Air Pollution), 10(4):233, 1975. (Presented at the National Air Pollution Research Conference, 16th, Niigata, Nov. 5-7, 1975.)

Atmospheric fluoride was analyzed at an active volcano and at various industries such as aluminum refining, ceramics, iron-steel manufacture, and phosphatic fertilizer manufacture. The air sample was collected both by Millipore AA filter and a filter paper with 1% sodium carbonate solution in order to have differentiated collection of fluoride particulates and gaseous fluorides. Of the residential areas without a specific fluoride pollution source, 84% showed less than 0.1 microgram F/cu m air. The fluoride level near the volcano was 1 microgram F/cu m, of which 72.2% was gaseous fluoride. Of the fluorides at areas with ceramics industries, 70% were gaseous, while 10% of the fluorides at an area with aluminum refining were gaseous.

83543

Fukui Prefectural Government

SURVEY REPORT ON FLUORIDES IN THE NATURAL ENVIRONMENT OF FUKUI AND SAKAI REGIONS. (Fukui, Sakai chiku ni okeru shizen kankyo chu no fukkabutsu chosa hokokusho). Text in Japanese. 86p., March 1975. 49 refs.

Fluoride concentrations in the environment of the Fukui and Sakai regions were surveyed from April 1972 to March 1975, prior to the establishment of an aluminum refinery in the Fukui Coastal Industrial Area in 1977. Fluoride (F) concentrations in all cases were in the range of normal natural concentrations. Values were as follows - Farm produce: leaves below 20 ppm; rice, about 8 ppm. Soil: 110-530 ppm (average 313 ppm). Ocean water (not at a river mouth): 1.0-1.2 ppm. Marine produce: Sea urchins and marine algae showed higher concentrations in comparison to fish, shellfish, and crustaceans. Pines: 1-3 ppm, for both first-year and second-year needles; ponderosa pines, highly susceptible to fluoride pollution, were suggested as possible pollutant indicators. Weeds (primrose, clover, mugwort): about 10 ppm. Drinking water: 0.02-0.37 ppm (average 0.12 ppm). Atmosphere: average relative concentrations, 6.3 microgram F/sq dm)/month (absolute concentrations, less than 0.018 microgram/cu m. Rain water: average soluble F concentration 0.013 ppm. Water-soluble F precipitants: 1.21 kg F/sq km/month. River water: average 0.10 mg/l. Environmental guidance standards for fluorides in Fukui prefecture were suggested as follows: continuous 24-hour value, below 1.0 microgram/cu m; continuous one-week value, below 0.5 microgram/cu m.

83637

Huber, G. L.

IMPROVEMENT OF THE ENVIRONMENTAL SITUATION IN THE CANTON VALAIS AND ITS SPECIFIC PROBLEMS. (Etat de l assainissement dans le canton du Valais et ses problemes specifiques). Text in French. Gas Wasser Abwasser, 53(11):725-727, 1975.

While the canton Valais has made significant progress over the past 10 years to control water pollution and treat waste water, tolerable emission concentrations have not been achieved for the most part. Fluorine remains the major air pollutant since the area encompasses all Swiss aluminum industry installations. These are equipped with scrubbers to treat waste gases from electrolytic processes. Although such measures are efficient, emission concentrations are still too high. In the Martigny region, a mathematical model has been established to determine concentration rates of pollutants emitted from specific sources. Chimney heights of a number of incinerator and refining installations have been adjusted on the basis of similar procedures. Natural phenomena such as irregular wind patterns and air currents from lateral valleys must also be contended with.

84479

Kowalski, Witold

EFFECT OF SURFACTANTS ON THE DECOMPOSITION OF PHOSPHATE ROCKS AND EVALUATION OF FLUORINE GAS IN THE PRODUCTION OF SUPERPHOSHATE. (Wplyw Zwiazkow Powierzchniowo-Czynnych Na Rozklad Surowcow Fosforowych I Wydzielanie Gazow Fluorowych W Procesie Otrzymywania Superfosfatu). Text in Polish. Chem. Stoso. Ser. A, 14(1): 81-89, 1970. 7 refs.

The effect of surfactant compounds on the extent of phosphorus- containing ore decomposition and fluorine release during the latter was studied. The phosphorus-holding material under investigation was Marocco I, Marocco II, apatite and a mixture of 2 pt of apatite and 1 pt of Marocco II decomposed by sulfuric acid. The disintegration tests for any ore type were performed with and without surfactants at the same concentration and quantity of H_2SO_4, temperature, length of time and mixing speed. The amount of surfactant added was 0.02% of the total weight of the ground material used and H_2SO_4. The surfactants were of the non-ionic, anionic and cationic types.

Analysis for water-soluble P2O5 and total P2O5 was carried out 3 hr, 3 and 7 days after the reagents were mixed and the decomposition level was calculated by gravimetry. Simultaneously, the degree of defluorination was determined by the balance of the fluorine content in the ore and in the end product. Its superphosphate content was evaluated 7 days after the reagents were mixed. Cationic compounds of the fatty amine group did not affect the decomposition process. The greatest effect among the non-ionic surfactants was shown by stenol, a condensation product of ethylene oxide and saturated fatty acid. In the anionic group, the strongest effect was demonstrated by sodium tetradecyclobenzene sulfonate. The surfactant activity was comparatively more intensive in the decomposition of apatite than that of phosphate rock. With regard to defluorination, an addition of 0.04% stenol was the most effective raising the level by 8%. The studies indicated approaches to achieve higher efficiency in superphosphate production.

84542

Tanaka, F. and M. Nakao

ON THE RESULTS OF A SURVEY OF FLUORIDES IN THE AIR OF THE WESTERN PART OF SHIMANE PREFECTURE BY METHODS LTP AND DJ. (Shimaneken Seibu chiku ni okeru LTP ho oyobi DJ ho niyoru taikichu fukkabutsu no kankyochosa kekka ni tsuite). Text in Japanese. Shimane Ken Eisei Kenkyusho Nenpo (Annu. Rep. Shimane Prefect. Public Health Inst.), no. 16:61-66, 1975.

In the western part of Shimane Prefecture, ther are many glazed-roof tile manufacturing factories. Around them, damage to silkworms, agricultural crops, and plants sometimes occurs. The fluorine concentration of air was determined by the LTP and DJ methods. A high concentration was found (more than 100 microgram/sq dm/month (LTP)) near a single factory and in the area of tile manufacturers. There was a correlation between values obtained by the LTP and DJ methods.

B. CONTROL METHODS

02541

(SCIENTIFIC METHODS AND TECHNIQUES TO DECREASE THE POLLUTION OF THE ENVIRONMENT, THROUGH INHALATION OR INGESTION, AND OF ACOUSTICAL 'NUISANCES.') Moyens scientifiques et techniques de diminuer la pollution des milieux inhales ou ingeres et des 'nuisances' acoustiques. (Chapter 3: Les pollutions et 'nuisances' d'origine industrielle et urbaine. Tome 1. Leur prevention et les problems scientifiques et techniques qu'elle pose en France.) Premier Ministre, Delegation generale a la recherche scientifique et technique. June 1966. pp. 47-59.

The functioning of chlorophyll in the course of photosynthesis in leaves of plants serves as a method of air purification of sufficient importance to consider its use in control. Vegetation, like men and animals, can sustain a considerable amount of damage to the point where the threshold limit of absorption of toxic substances is exceeded. The three gases causing the most damage to vegetation are carbon monoxide, the sulfur oxides, and those containing fluorine. Also to be considered are acid 'smog', toxic 'smog', ozone, and nitrogen oxides. Other industrial pollutants which have a toxic influence, but less sever and localized, are dusts, hydrogen sulfides, hydrochloric acid, etc. Ethylene and carbon monoxide cause great damage to the growth hormones, particularly auxin. The effects of SO2, SO3, and H2S04 are related to the quanity of gas emitted, the degree of resistance of the species, their state of development, and the various environmental conditions. The sensitivity of vegetation to the action of sulfur gases varies essentially as a function of the speed of absorption of the gas by the leaves. Through experimentation it has been found that the plant species which are most sensitive to SO2 are chickweed, alfalfa, barley, oats, wheat, rhubarb, lettuce, endive, spinich, cabbage, and tobacco. Apples, apricots, peaches, grapes, corn, and beans are less sensitive, whereas the floral species such as gladiolus, rose, and lilac offer considerable resistance. Aquatic vegetation is often used as purifying means for polluted streams. Subsoils purify themselves of pollutant materials in various ways, including uptake by vegetation and dispersion in the soil with rair water, etc. In a section on means of decreasing the inhaled pollutants the following are mentioned: dust collectors, normal methods of dispersion in the atmosphere, fumes from domestic fires, auto exhaust fumes, fuel additives, improvement of combustion in engines, recycling of crankcase gases, post-combustion appliances, and redesigning of motors. Also given in this section (Chapter 3) is some similar information on ingested pollutants and on problems of noise.

02962

J. P. Jewell

CONTROL OF FLUORIDE EMISSIONS. Proc. Ann. Sanitary Water Resources Eng. Conf., Vanderbilt Univ., Nashville, Tenn., 1965. pp. 226-32.

The chemistry of fluorine and the fluoride problem encountered in certain industries, namely the phosphate industry, both elemental and fertilizer, part of the steel industry, aluminum reduction, and other industries engaged in processing ores containing fluoride are described. In detail, and more specifically, the control of of fluoride emissions from an elemental phosphorus plant is discussed.

04368

H. Schnitt and E. Moser

FURTHER DEVELOPMENTS OF THE FLUORINE PROBLEM IN THE ALUMINUM INDUSTRY. Weitere Entwicklungen zum Fluorproblem in der Aluminium-Industrie. Z. Erzbergbau Metallhuettenwesen 18, (3) 111-5, Mar. 1965. Ger.

This paper reports on the state of the arts concerning control and scrubbing equipment for fluoride inside working premises as well as directly from electrolytic furnaces. Far reaching research has improved the already very effective methods and installations. An optimal aerodynamic air ventilation is used very effectively. Control of dust and gaseous components, measurements of fluorine from the air inside of working premises and from the exhaust are done separately. Measurement and control is accomplished according to VDI-Richtlinien (guides) No. 2093 and 2452. The success of reduction in fluorine content with the installation of control equipment can be measured by the reduction of the fluoride content in grass, in the vicinity of the plant, which is used as cattle feed.

04794

W. Von Jordan

VENTURI AND RADIAL FLOW SCRUBBERS FOR COOLING AND CLEANING OF UTILITY AND WASTE GASES. Venturi- und Radialstrom-wascher zur Kuhlung und Reinigung von Nutz- und Abgasen. Stahl Eisen (Dusseldorf) 86, (8) 399-406, Apr. 8, 1966. Ger.

Two scrubbers are discussed in this paper: The venturi scrubber with central jet and the radial flow scrubber. Operating experiences and results of measurement are given. Venturi scrubbers are used in a variety of industries for gas cooling and dust cleaning. They are used for scrubbing of gaseous components, for instance fluorine washing. The versatile use of the venturi scrubber, it can be operated according to need without or with high pressure losses, has opened a wide field of application. The operation and application by low and high pressure losses are explained. The radial flow scrubber is an adjustable high performance scrubber, developed for cooling and cleaning of large gas masses, for example such from blast furnaces. Design and construction is explained and the effect discussed.

04853

C. R. Thompson, and O. C. Taylor

PLSTIC-COVERED GREENHOUSES SUPPLY CONTROLLED ATMOSPHERES TO CITRUS TREES. Trans. ASAE (Am. Soc. Agr. Engrs.), 9(3):338-339, 342, 1966. 5 refs.

Details of a greenhouse for studies of air pollution (smog) on individual fruitbearing citrus trees are described. A structure was needed for this purpose that would endure for a minimum

of five years, would admit the entire solar spectrum, and would not become excessively overheated when outside temperatures rose to 115 F. After three years of operation, the durability and convenience of the structures described are very satisfactory. No discoloration, crazing or cracking of the plastic glazing material is apparent. Paint on the aluminum is holding well. Repainting on some steel surfaces was necessary after two years. Activated carbon and limestone for removing photochemical smog and fluorides, respectively, from the air streams must be renewed about every 12 hours. Some minor damage was done by windstorms of 80 mph, which was easily taken care of.

05567

L. Silverman

HIGH TEMPERATURE GAS AND AEROSOL REMOVAL WITH FIBROUS FILTERS. Proc. Air Water Pollution Abatement Conf., 1957. pp. 10-23m.

The use of a slag wool fiber filter as an inexpensive cleaner of high temperature gases and fumes produced in open hearth steel furnaces was described and evaluated. These fibers are small (4 microns mean diameter) and are refractory, thus able to withstand temperatures of 1100 F. ;or high efficiency separation of fine aerosols, fine targets in large number are necessary which packed slag fiber layers can provide. Theoretical, laboratory and field studies show that slag wool filters show efficiencies ranging from 90 to 99%, depending upon fiber layer compositions, density, and thickness. The chief separating mechanisms appear to be diffusion and impaction. Results are presented of the air flow resistance characteristics of a rotary screw agglomerator, used to provide dynamic gas treatment to increase particle size of the efficiency of the screw as an inertial collector for iron oxide fume. The collection efficiency and resistance characteristics of slag wool fiber filters was extended to other aerosols and gases such as fly ash, sulfur dioxide, hydrofluoric acid and sulfuric acid mist. The filter (one inch thickness, five pounds per cubic foot density) at velocities used for collecting iron fume (50 to 150 feet per minute) showed efficiencies for SO2 of approximately 30% when moist and zero when dry. For hydrogen fluoride (dry and wet), efficiencies range from 70 to 90%. For fly ash resuspended from Cottrell ash, efficiencies ranged from 60 to 90%, whereas when feeshly formed fly ash was created by burning powdered fuel, efficiencies ranged from 93 to 99%. A revised pilot model slag wool filter was constructed for 750 to 1000 cfm gas flow based on results of the first field unit.

06587

R. C. Specht and R. R. Calaceto

GASEOUS FLUORIDE EMISSIONS FROM STATIONARY SOURCES. Chem. Eng. Progr. 63, (5) 78-84, May 1967.

Methods of controlling the emission of fluorides from the brick and tile, steel, aluminum, and phosphate fertilizer industries are examined. The brick and tile industry receives brief treatment and a concluding statement mentions that a venturi type scrubber was used in bottle manufacture with 92% efficiency. In the steel industry, the emission of fluorides from sintering plants exceeds those from open hearth furnaces and different control measures are required. The addition of 6% weight of ground limestone to the sintering mix reduced fluoride emission by nearly one half. The final treatment consists of the means for supplying and injecting pulverized limestone and the final dust separation equipment. Reduction of fluorides is estimated at 96%. The basic difference between the treating systems of the sintering and open hearth processes is the pressure under which they operate and the material used as a reactant; CA (OH) 2 is used in the open hearth process. Among the methods discussed in regard to the aluminum industry are the wetting by sprays of the hot gases escaping through roof monitors, the use of a sieve-plate gas absorber column, and a floating bed type of scrubber which overcomes the tar-fouling problem and is reported to remove 95% of fluorides. Fluoride control is achieved with cyclones and packed towers. The effects of fluorides on vegetation, cattle, and man are briefly discussed including the effects of inhalation of HF at various concentrations.

07190

R. C. Timberlake

FLUORINE SCRUBBER. Southern Eng. 85(6):62-64, June 1967.

The control of gaseous fluorides from the superphosphate curing area of the American Cyanamid's Brewster, Florida plant is described. The problem involved handling large volumes of air containing widely varying concentrations of fluorine. Four blowers, each with a capacity of 87,500 cfm, were used to deliver the exhausted air to rubber-lined scrubbers. The 9-ft impeller is made of stainless steel and the housing is rubber lined. The ducts are made of Cyanamid's Laminac polyester resin. Each of the four scrubbers has 50 spray nozzles and uses 500 gallons of water per minute to capture the fluorine as dilute fluosolicic acid. The scrubber project eliminates 98% of the total fluorides liberated by all sources of the operations.

07549

N. Yamate

AIR POLLUTION BY TOXIC GAS AND ITS COUNTER MEASURE. Text in Japanese. Kuki Seijo (Clean Air, J. Japan Air Cleaning Assoc., Tokyo) 3(2):19-25, 1965. 5 refs.

The present status of air pollution in Japan and its counter measures are described according to the chemical composition of the pollutlants: sulfur oxides, nitrogen oxides, halogen compounds, organic compounds, and solid particles (dusts). The hourly variation of SO2 concentration is graphed. In Tokyo, there is a peak around noon of about 15 pphm; NO2 ranges from 1 to 1.5 pphm with little variation. Concentrations of SO2, NO, NO2, H2S, and CO were measured in Yokkaichi, Osaka and Ube as well as in Tokyo. Graphs relating amount of traffic to CO concentration show almost the same pattern. Concentrations of HCl and HF in the air are quite small (0.35 ppm and 0.3-0.4 micrograms/cu m., respectively) near chemical plants producing these gases. Counter measures used aganist the various pollutant emissions are: the dry method, wet method, activated carbon method for sulfur oxides; alkali or oxidation method for nitrogen oxide; dry iron oxide and dry absorption methods for H2S; and water washing method for HCl and HF. Afterburner methods by sparking and heat concentration are described for control of automobile exhausts. However, problems encountered with the afterburner methods are the high temperature required and nitrogen oxide increase. The equipment required is also rather large. Another method employing catalysts is described in which loam, molybdenum, white gold, nickel or vanadium are used effectively.

07552

Billings, Charles E., Charles Kurker, Jr., and Leslie Silverman

SIMULTANEOUS REMOVAL OF ACID GASES, MISTS, AND FUMES WITH MINERAL WOOL FILTERS. J. Air Pollution Control Assoc., 8(3):195-202, Nov. 1958. 20 refs. (Presented at

the 51st Annual Meeting, Air Pollution Control Assoc., Philadelphia, Pa., May 26-29, 1958.)

Investigations have indicated that two in. thick filters at four lb/cu. ft. packing density will remove up to 80% of acid mist and up to 99% of acid gases and fumes. Total filter life depends upon concentration of contaminant in the entering air. A summary of filter performance is given. Estimated operating life based upon one use of the filter material can be obtained from the data given. With particulates such as iron oxide and fly ash, it has been found possible to wash and reuse filters about ten times. When iron oxide was collected simultaneously with SO2, filters were reused about eight times. Acid gas collection is significantly improved by the presence of moisture on slag wool filters. Mineral wool filters have several features such as, low cost (about 1 cents/lg.), small fiber diameter (4 micron and ability to withstand high temperatures (1000 deg F.). Slag wool will simultaneously remove sub-micron particulate materials with 90 to 99% efficiency. Resistance to flow through two in. slag wool filters (with an HF efficiency of 95%) is on the order of one or two in. of water, or if continuously moistened, at most 6 in. of water.

07664

Holland, M. and K. B. Whitman

DIRECT FUME EXTRACTION FOR LARGE ARC FURNACES. In: Fume Arrestment, Special Rept. 83, London, William Lea and Co., Ltd., 1964, p. 150-159. (Report of the Proceedings of the Autumn General Meeting, Iron and Steel Inst., London, England, Nov. 26-27, 1963.)

The development of a suitable fume extraction and cleaning system for large electrical arc furnaces using tonnage oxygen is taken in logical sequence through pilot plant trials to the final design stage. The choice of a wet cleaning plant is influenced by the ease of hot gas conditioning and fluorine removal, the economies due to reduced volumes at the outlet, and an improved effluent treatment and disposal system. The steps taken to ensure complete combustion of the gases evolved during the furnace cycle by the use of an adjustable sealed connection to the furnace, combined with a controlled combustion air and ignition source, are described in detail. Control of furnace pressure is achieved by control of speed of the fan and a water-cooled damper in the furnace offtake. Operational experience and plant reliability are discussed, together with reasons for modifications found to be necessary.

07815

Borenstein, Murray

AIR POLLUTION CONTROL IN NON-FERROUS METALLURGICAL INDSUTRY. (THE USE OF WET SCRUBBERS). Ind. Heating, 34(10):1866, 1868, 1870, Oct. 1967.

Fumes emitted from the processes involved in the non-ferrous metallurgical industry consist of extremely fine particulate matter of submicron size. These fumes result from the heating operations, from the use of fluxes and from reduction processes, all of which produce highly corrosive emissions. Types of controls include wet-scrubbers and bag filters. A typical Airetron installation for capturing fluoride emissions during electrolysis of aluminum ore is described; it employs 20 cyclonic air scrubbers operating at a low pressure drop of 3 in. w.g. which neutralizes gaseous fluorides at the rate of 90,000 cfm at 200-250 deg F. for a total of 1.8 million cfm of gas purified. Recovery of the metal is accomplished, in this case, by permitting it to settle out of the resulting liquid and recharging it into the furnace. In this system all solids are recovered through the recycling. In the wet-scrubbers, the fumes become highly corrosive when wetted and linings such as rubber or polyester-fiberglass must be used in their construction. Bag filters provide high cleaning efficiency and operate at relatively low power costs. However, the replacement of the filter bags themselves is a high maintenance item. The non-ferrous industry thus requires some of the most sophisticated air pollution control equipment for production of an essentially low-cost product.

08344

Sheppard, Stanton V.

CONTROL OF NOXIOUS GASEOUS EMISSIONS. Proc. MECAR Symp., New Developments in Air Pollution Control, Metropolitan Engineers Council on Air Resources, New York City, p. 21-28, Oct. 23, 1967. 3 refs.

Several new developments have taken place which have helped improve scrubber designs for controlling emission of noxious gases. Some major new technical developments have been: Greater use of the crossflow scrubber design principle, availability of light weight plastic tower packings, and wider acceptance of corrosion resistant glass reinforced polyester plastics. Some noxious gases commonly encountered are oxides of nitrogen, hydrogen chloride, hydrogen fluoride, silicon tetrafluoride, chlorine, chlorine dioxide, sulfur dioxide, hydrogen sulfide and mercaptans. In industrial applications, the removal of noxious gases from exhaust air streams is most often accomplished by bringing the air stream into contact with a liquid stream for a certain period of time. The amount of time required to transfer the noxious gas to the liquid is a function of several factors. These are: Gas rate, liquid rate, solubility of gas, mechanism of contact, and scrubber type. The packed scrubber is used most often today for controlling emission of noxious gases to the atmosphere. It is available in three basic operating designs: Counter current, cocurrent and crossflow. In the counter current packed design, the air stream containing the noxious gases is passed vertically upward in opposite direction to the flow of the down coming scrubbing liquid. The cocurrent packed scrubber allows the air stream and the scrubbing liquid stream to pass through the packed bed in the same direction. In the cross-flow scrubber the air stream moves horizontally through the packed bed while the scrubbing liquid moves vertically downward through the packed bed and perpendicular to the air streams. Three relatively new tower packing shapes are being used more frequently by engineers in designing scrubber equipment for removing gases. These packing materials are constructed of high density polyethylene or polypropylene. This gives them good resistance to corrosion and light weight compared to ceramic ring and saddle packing. Fiber reinforced plastics (commonly designated as FRP) are being used more and more to replace stainless steel, rubber and PVC lined steel and other metallic alloys for scrubber bodies. FRP is a material that uses a combination of polyester or epoxy thermosetting resins and glass fiber reinforcements to give a finished laminate that has excellent corrosion resistance, a high strength to weight ratio, and light weight.

09664

Thomas D. Crocker

SOME ECONOMIC ASPECTS OF AIR POLLUTION CONTROL WITH SPECIAL RE- FERENCE TO POLK COUNTY, FLORIDA. 337p., Jan. 1968. 178 refs.

A report is given which studies the economic analysis and modifi- cation of air pollution problems. By determining the pattern of apparent air pollution damage to the citrus and cat-

tle industries of Polk County, Florida; and by drawing inferences from the pattern, an attempt is made to analyze what might be some of the more important impediments to efficient management of the atmos- pheric resources and to identify the conditions under which insti- tutional innovations might have to be made to improve management of this resource. The following procedure is used to accomplish this: The economic nature of air pollution is discussed. Infor- mation is given on the economic backgrounds of Polk County's cattle, citrus, and phosphate fertilizer industries. A short des- cription of the evolution of potentially toxic fluorides during the phosphate fertilizing process is given. A comprehensive dis- cussion is given on the effects of airborne fluorides upon the citrus and cattle. The results of a study between the intensity of air pollution and Polk county land values are presented and interpreted. Proposals for control of air pollution are reviewed. Finally, an attempt is made to present the writer's views about implications of the results of the land value analysis for the con- trol proposals and their applicability.

09773

FAN SCRUBBER HALTS CORROSION ENDING NEED FOR ROOF REPAIRS. Chem. Process., 31(4):67, April 1968.

The manner in which escaping acid fumes were controlled at a particular plant is described. An existing system of water scrubbers was supplanted by a separator based on a centrifugal fan. Flow through the separator is 14,000 cfm of an exhaust containing 750 ppm of nitric acid and nitrogen oxides and 350 ppm of hydrofluoric acid. Most of the fumes are separated by centrifugal force in the fan, into which 6 gpm of water is sprayed. The partially cleaned exhaust then passes through a 48 x 80 x 6 in- thick polypropylene filter which removes nearly all of the remaining wetted fumes. Fumes leaving the separator were reduced to trace amounts. Scrubbing water requirements were reduced by 34 gpm. The complete system was installed at a cost of $8100, less thatn $.70 cfm.

09902

Wett, Theodore W.

COMPETITORS COLLABORATE TO CHOKE OFF AIR POLLUTION. Chem. Process., 31 (1):27, 34-35, Jan. 1968.

Some 289 air-pollution control devices have been installed by 13 phosphate-producing companies operating 18 plants and a dozen large curing sheds. This equipment includes electrostatic precipitators, cyclonic and venturi scrubbers, bag-type dust collectors and absorption towers. Although all companies do not disclose capital investment in air-pollution control, a rough 'rule of thumb' indicates that it will run $3.25/cfm of effluent air treated. Yearly operating cost for pollution-control equipment averages 15 percent of installed cost, sometimes more, not including depreciation. Fluorine from the phosphate industry consists mostly of SiF and insoluble particulate fluorapaties generated in crushing the phosphate rock. Presented sampling techniques, involving considerable agitation and very finely divided particulate matter, can indicate a higher concentration of soluble fluoride in ambient air than is actually in the case. In addition, there is no method of distinguishing between SiF4 and HF. Since most of the work in fluoride pollution studies has been done with HF, much more toxic than SiF4, the effect of phosphate industry fluoride emissions on plants, animals and man has not been adequately determined.

10372

Erga, Olav, Kare Ryan and Adolf K. Syrdal

GAS CLEANING PRACTICES AT MOSJOEN ALUMINUM WORKS. ((Gassrenseanlegg ved Mosjoen Aluminiumverk.)) Text in Norwegian. Tek. Ukeblad (Oslo), 114(12):232-237, March 30, 1967. 3 refs.

Mosjoen Aluminum Works' solution to cleaning the oven gases given off by the electrolytic aluminum production processes is outlined, with emphasis on the fluoride compounds which have adverse effects on the environment. Mosjoen has developed the construction of a practical model (by Erga et. al.) which uses selective absorption of fluorine from the gases from aluminum reduction cells with vertical spike Soderberg anodes. Economic and efficiency statistics are given to justify the method in the Norwegian industrial environment. Diagrams showing the components of the equipment are given illustrating the fluoride recovery technique.

10618

George Graue, and Helmut Nagul

DETECTION AND REMOVAL OF FLUORINE IN THE WASTE GASES OF A STEELWORKS AND MEASURING AIR QUALITY IN ITS SURROUNDINGS. Staub (English translation), 28(1):9-17, Jan. 1968. 5 refs. CFSTI: TT 68-50448/1

Air-quality measurements of fluorides were taken near a large steelworks for a period of three years. They revealed that the positioning of the measuring devices is of decisive importance. For example, gross errors are liable to occur if ore dust entrained near ground level is included. After eliminating such errors the total precipitation of fluoride in the course of 3 years was established as between 2 and 6 mg/sq.m./day. No free fluorine is emitted by steelworks, although gaseous fluoride compounds can occur. Downstream of metallurgical furnaces, particularly where 'brown smoke' is emitted, this fluorine is partically completely adsorbed on the dust. Consequently, even when using excessive quantities of fluorite, it is retained by the dust collectors just like the dust itself. It is irrelevant whether wet or dry collectors are used. Accordingly, there is no reason to avoid the use of fluorite in steel making, provided efficient collecting units are used. Emission of coal-fired boiler plants is less governed by the fluoride content of coal than by the more or less basic character of the ash. Emission of this origin can be largely prevented by dust collection. (Authors' conclusions, modified)

11686

H.R. Hickey

CONTROLLING ALUMINUM EFFLUENT REDUCTION. Air Eng., 10(10):20- 22, Oct. 1968.

In the manufacture of aluminum from alumina by electrolytic reduction, fluorides and hydrocarbons are the principal effluents. Fluoride removal from collected gases poses no problem with conventional scrubbing equipment. However, the hydrocarbons condense as submicron tar particles which plug multiple cyclones and baghouses thereby limiting the options available in selecting control devices. Research to overcome the hydrocarbon problem is needed.

12127

Pedigo, W. R., C. R. King, L. A. Dean, J. E. Owens, and S. Bernstei

FLUIDIZED BED RECOVERY OF FLUORINE IN THE MANUFACTURE OF UF6. Preprint, American Institute of

Chemical Engineers, New York, N. Y., 22p., 1964. 3 refs. (Presented at the Symposium on Nuclear Plant Experience with Fluidized Beds, Part I, American Institute of Chemical Engineers, 53rd National Meeting, Pittsburgh, Pa., May 17-20, 1964.)

Recovery of volatile fluorine at the Atomic Energy Commission's Gaseous Diffusion Plant at Paducah, Kentucky, is based on a fluidized bed process. The all Monel reactor is 27-in. in diameter and employes a bed of UF4 at a depth of 4.5 ft. Operation of the reactor depends on the reaction of fluorine with UF4 to produce gaseous UF6 and several solid compounds with fluoride-to-uranium ratios between UF4 and UF6. The reactor operates at approximately 750 F. The process gas steam for the reactor is the primary UF6 process vent gas stream containing 20-40% fluorine. Initial development of the fluidized bed recovery process was conducted in an existing plant reactor. Because of the similarity of operation, the facilities of the fluidized bed UF6 absorber were temporarily modified for a pilot-plant investigation. A total of eight runs were made during the investigation with fluorine concentrations of 5-30% and at 600 to 900 F. Based on the results of this study, a prototype reactor was built and operated for one year. With the current unit, fluorine recovery efficiencies are greater than 95% while reactor-on-stream efficiencies average about 99%. Equipment maintenance is negligible.

12288

Navratil, James D.

DISPOSAL OF FLUORINE. Dow Chemical Co., Golden, Colo., Rocky Flats Div., AEC. Contract AT(29-1)-1106, Aug. 29, 1968. 44 refs.

A literature review of fluorine disposal systems utilizing liquids, solids, and gases is given. The literature makes frequent mention of caustic solutions and water. Sodium hydroxide solution is the most desirable liquid agent, especially when Ca0 is added to regenerate Na0H. A review of media used for solid disposal includes charcoal, alumina, soda lime, and several other less efficent agents. Static beds of coconut charcoal and fluid beds of activated alumina were reported to be highly effective fluorine disposal systems. No explosions were encounterd with the use of charcoal. Apart from the literature review, experiments were static-bed disposal traps to evaluate activated alumina, soda lime, and charcoal as fluorine disposal agents are described. Exhaust line plugging occurred when alumina was used as the disposal medium. Plugging problems were less severe with soda lime. Water evolved during the fluorine-soda lime reaction, but it presented no problem. The use of wood charcoal eliminated plugging problems, but pressure surges were noted during the reaction. A check valve upstream from the disposal trap prevented interference on the upstream system from the trap. Charcoal was selected as the most desirable disposal medium because of its high disposal capacity, gaseous reaction product (CF4), and freedom from trap plugging.

12465

Gully, A. J., R. M. Bethea, R. R. Graham, and M. C. Meador

REMOVAL OF ACID GASES AND OXIDES OF NITROGEN FROM SPACECABIN ATMOSPHERES. Texas Technical Univ., Lubbock, Contract NAS 1-7584, 139p., July 1969. 122 refs. CFSTI: NASA CR-1388

Investigations were made on methods of removal of oxides of nitrogen and of the acid gases sulfur dioxide, hydrogen chloride, hydrogen fluoride and chlorine in low concentrations from air as part of the effort to develop an effective atmospheric purification subsystem for long-term manned space missions. Methods investigated were: reaction with basic solid materials, adsorption, and for oxides of nitrogen, catalytic reduction of nontoxic to less toxic gases. Adsorption at ambient temperature of both chlorine and nitrogen dioxide on activated carbon was found to be rapid with sulfur dioxide being adsorbed to a lesser extent. In exploratory work, nickel oxide and copper oxide were found to exhibit appreciable activity in the catalytic decomposition of nitrogen dioxide. Maximum decomposition of nitrogen dioxide observed (nickel oxide catalyst at 482 C) was 53%. Nitric oxide was the major decomposition product. Solid-gas reaction was found to be the most generally effective method of contaminant removal. The solid reactants tested included sodium carbonate, sodium bicarbonate, barium carbonate, calcium carbonate, lithium carbonate, and manganese dioxide. Of these, lithium carbonate and manganese dioxide were the most effective by a large margin for acid gas removal. Manganese dioxide reacts faster with sulfur dioxide and chlorine, and lithium carbonate faster with the hydrogen halides at the temperature of interest (340-380 C). Reaction rates increase rapidly with temperature. The reaction between nitrogen dioxide and any solid tested was too slow for effective removal. A mathematical model of the solid-gas reaction system, based on the shrinking core concept, was developed. This model served both as a basis for experimental data interpretation and as a design tool. The model, which requires only two experimentally determined constants for each gas-solid pair, adequately fits the breakthrough data on all solid-gas reaction systems investigated. On the basis of information developed in this study, it is confidently estimated that by using a 11 cm reaction bed containing both manganese dioxide and lithium carbonate, over 88% of the sulfur dioxide and over 99% of the chlorine and hydrogen halides in the entering stream can be removed on a once-through basis for up to 750 hours of operation. (Author summary)

13676

Erga, Olav, Kare Ryan, and Adolf Syrdal

RECOVERY AND UTILIZATION OF FLUORINE PRODUCTS FROM ALUMINUM ELECTROLYSIS WASTE GASES. In: Abwasser, Abgas Schwebstofftechnik, Dechema-Monograph., 59(1045-1069), Frankfurt am Main, Deutsche Gesellschaft fur chemisches Apparatewesen E.V., 1968, p. 191-198. 4 refs.

Gases released during aluminum electrolysis contain HF, SO2, and CO2 which are all absorbed with the alkaline solution used in present recovery procedures. A method and apparatus are presented for the selective recovery of HF for hydrofluoric acid production. A sieve plate scrubber utilizing water as the absorption agent was developed by Elektrokemisk. The device features a tower consisting of sieve plates and funnels and a circulation pump for gas distribution. One unit is sufficient for HF recovery. Pilot plant tests showed more than 99% of the HF was absorbed, producing an acid of 3% HF by weight. The co-absorption of SO2 was negligible. Use of the tower for cryolite production also results in an economically feasible by-product.

13771

Vorlamov, M. L., E. L. Krichevskaya, A. A. Ennan, L. M. Zampol'skaya, G. A. Manakin, and R. A. Georgaliu

ACOUSTIC COAGULATION OF MIST CONTAINING FLUORINE COMPOUNDS. J. Appl. Chem. USSR (English Transl.), 41(12):2494-2499, Dec. 1968. 4 refs.

Investigations of the particle-number concentrations and size distributions in mist containing fluorine compounds were conducted with a flow ultramicroscope and photomicrography

under laboratory and plant conditions before and after acoustic treatment. The results of these studies showed that the number of particles decreases by a factor of 100-1000 as a result of acoustic treatment for 3 to 5 sec. Examination of the experimental data obtained in studies of the particle-size distribution of aqueous mist showed that the minimum size of the drops was 0.9 micron and the greatest frequency was in the 5 to 6 micron range. In the case of industrial mist, the number of particles deposited per unit area is decreased by a factor of 125 after acoustic treatment for 1.5 sec, while the average diameter increases from 2.5 to 18.7 microns. Before treatment, 88% of the particles were in the 1 to 4 micron range. Acoustic treatment shifts the distribution to the right and increases the variance. (Author conclusions modified)

14444

Tsujimura, Shigeo, Akira Takahashi, and Ginji Fujisawa

CONSTRUCTION OF DIFFERENTIAL PRESSURE GAGE FOR FLUORINE AND ITS APPLICATION TO AUTOMATIC DISPOSAL OF FLUORINE. J. Nucl. Sci. Tech., 5(1):30-34. Jan. 1968. 9 refs.

A differential pressure gage for fluorine, consisting of two metal bellows connected end to end was constructed. This device can be applied in measurement of pressure drop across fluid bed reactors, pack bed reactors, filters, orifices of flowmeters, and other similar uses. The gage has been shown to possess excellent stability against corrosion by fluorine. The output voltage obtained was 1.7 mV/mm H2O, and drift was less than 0.5 mm H2O. The gage can be used for control of fluorine disposal by absorption in a wide range of mean flow rates, and dispenses with the use of fluorine-resistant control valves.

14692

Tuerkoelmez, S.

NEW METHOD FOR WASTE GAS CLEANING. ELIMINATION OF ODORS BY EXCHANGE ADSORPTION WITH ARTIFICIAL RESIN ION EXCHANGERS. PART I. (Neues Verfahren der Abgasreinigung. Beseitigung der Geruchbelaestigungen durch Austausch-Adsorption mittels Kunstharz-Ionenaustauschern. Teil I). Text in German. Wasser Luft Betrieb, no. 11:737-743, 1965.

For the removal of odors from industrial waste gases, the use of artificial ion exchanger resins is suggested. The reaction takes place in the gas phase in the case of inorganic waste gases and in the liquid phase for organic compounds. Four types of exchangers, IR-45(OH), IRA-410(OH), IRC-50(H), and IR-120(H), were successfully tested with phenols, mercaptans, bromides, fluorides, cyanides, nitriles, chlorides, SO2, and a number of organic compounds. Fluorides, cyanides, chlorides, and SO2 could be completely removed. Pre-adsorption with alkaline earth hydroxides in scrubbers was used only in the case of phenols.

15322

Teske, Wolfgang

AIR POLLUTION CONTROL IN THE CHEMICAL INDUSTRY. (Luftreinhaltung in der chemischen Industrie). Text in German. Zentr. Arbeitsmed. Arbeitsschutz, 19(10):289-294, 1969. 11 refs.

Emissions developing from chemical production processes can be reduced either by modification of the process itself or by cleaning the stack gas. As an example of the first approach, the so-called double contact process is described. Sulfur dioxide from pyrite roasting is converted by catalytic oxidation with atmospheric oxygen to SO3. By addition of water, the latter is converted into sulfuric acid. The reaction is not complete; in the first stage of the process, 90% of the SO2 is converted to SO3, which is removed from the reaction gas mixture by absorption. The remaining 10% SO2 is converted to SO3 in the second stage. The residual SO2 concentration in the cleaned gas lies between 0.5 and 0.7 g/std cu m. The emission of NO and NO2 can be reduced by the use of higher pressures either during combustion or prior to absorption. The dust emissions from acetylene production can be reduced through the construction of a completely closed furnace from which no waste gas can escape without having first been cleaned. For cleaning of waste gases, there are several wet and dry methods. Hydrogen sulfide and carbon disulfide from the manufacture of synthetics are removed from the waste gas by adsorption on two layers of activated charcoal. Silicon tetrafluoride and hydrogen fluoride can be removed by venturi scrubbers, by Doyle scrubbers, where the gas is accelerated in an annular nozzle so that it hits the scrubbing liquid at high speed, by cyclone scrubbers, or by spray chambers.

15372

MAINTENANCE OF AIR PURITY AND DETERMINATIONS OF IMMISSION BY THE ALUMINUM INDUSTRY: FLUORINE POLLUTION, ESPECIALLY HYDROGEN FLUORIDE GAS, IN WASTE GASES CAUSES DAMAGE TO VEGETATION. (Luftvard och immissionskontroll i aluminiumindustrin: fluorforeningarna, sarskilt det gasformiga fluorvatet, i avgaserna). Text in Swedish. Tek. Tidskr., 99(12):251-253, May 27, 1969.

The Sundsvall aluminum plant, the only alumina-electrolysis plant in Sweden, operates 300 cells currently producing 65,000 tons of Al per year, representing a fivefold increase of production since 1962. To date the company has spent 20 million kronor (about $4,000,000 in 1969) on air pollution control equipment, but there is still some damage to vegetation from hydrogen fluoride gas. Comfort of workers requires 20 to 30 changes of air per hour (12 million cu m/hr) in pot-line area, which complicates air pollution control. Most recent of several air-washing devices used in a 'spin bath' in which plastic balls are sprayed with water from jets. Exhaust gases escape through four 70-m concrete chimneys, 10-11 m in diameter and lined internally with plastic. The equipment removes 90% of water- soluble fluorides from exhaust. The company also maintains 160 inspection stations in the area, which by means of pollutant- sensitive plants record the immission of toxic material, which is the basis of a map of Sundsvall region with 'isofluoride' lines to indicate pollution zones.

15813

Lunde, K. E.

PERFORMANCE OF EQUIPMENT FOR CONTROL OF FLUORIDE EMISSIONS. Ind. Eng. Chem., 50(3):293-298, March 1958. 12 refs. (Presented at American Chemical Society, Division of Analytical Chemistry, Symposium on Air Pollution, Joint with Division of Industrial and Engineering Chemistry and American Chemical Society Committee on Air Pollution, 130th Meeting, Atlantic City, N. J., 1956.)

Metallurgical, heavy chemical, fertilizer, and ceramic processes discharge fluorides to the atmosphere as hydrogen fluoride, silicon tetrafluoride, or solid fluorides of varying composition and particle size. The efficiency of various equipment for controlling these emissions is evaluated for purposes of minimizing capital investment and operating costs. Absorption data are reported in terms of the number of transfer units

and related to liquid and gas flow rates, which are expressed in terms of theoretical power consumed per unit of gas flow rate. The absorption of gaseous fluorides is analogous to the absorption of sulfur dioxide and the relative performance of equipment should be similar. It is shown that the number of transfer units obtainable on grid towers is controlled principally by tower height and is only slightly affected by power expended on the liquid and gas phases. The performance of cyclone spray scrubbers is primarily a function of power expended in the liquid phase, while the performance of venturi scrubbers depends on the power expended in the gas phase. These factors dominate the performance of equipment used in the absorption of gaseous fluorides. Various spray towers exhibit significant differences in performance. Wet-cell washers require a higher power consumption than simple spray towers. In designing spray towers, the removal of silicon tetrafluoride by scrubbing with water should not be considered a case of simple gas absorption. In the case of silicon tetrafluoride, mists formed in the tower are collected primarily in entrainment separators just prior to emergence from the tower. The mist is presumably rather coarse because jet scrubbers do not exhibit substantially better performance than the low-power-consuming spray towers. To be efficiently collected by separation, the mist should be 10 microns or larger. Adequate data are not available to evaluate the performance of equipment for collecting particulate fluorides. However, the performance is probably controlled largely by the total power consumption of the device and design of equipment is of relatively unimportant. (Author summary modified)

16555

Fukui, Syozo

EXAMPLES OF GAS INJURY BY HYDROFLUROIC ACID AND NITROGEN DIOXIDE, AND REMOVAL OF THE GASES FROM WASTE GAS. (Fukka suiso oyobi nisanka chisso ni yoru kogai to sono jogai jisshirei). Text in Japanese. Kogai to Taisaku, (J. Pollution Control), 2(7):481-486, Aug. 15, 1966. 3 refs.

Among the methods of nitrogen-dioxide removal, washing by water or alkaline solutions are only 50% effective. The author investigated a method based on ammonia gas. For the sake of comparison, an experiment using water alone was conducted. Nitrogen dioxide concentration was about 200 to 300 ppm; gas velocity, 0.6 l/min; and water volume, 20 ml. Removal efficiency was only 30 to 40%. Next, washing by a caustic soda solution was examined. The caustic soda concentration was 10% under identical experimental conditions. The rate of removal was 40 to 50%. The rate of nitrogen dioxide removal by ammonia was 85 to 95%. The drawback of this method, however, is that it generates white smoke of ammonium nitrite or nitrate. In the experiments conducted at a plant site, washing by water removed only 12 to 55% nitrogen dioxide while ammonia removed 70 to 93%. Hydrofluoric acid is harmful to silkworms. Mulberry leaves containing 1 mg of fluorine per 100 g of leaves completely killed silkworms. Elimination of hydrofluoric acid was comparatively easy. Satisfactory results were achieved by alkaline washing. The removal rate of this method was higher than 99% and the acid concentration of tail gas was lower than 1 ppm. The mortality rate of silkworms fed untreated mulberry leaves was 3.0 percent; that of controls was 2.0.

16962

Kielback, A. W.

THE DEVELOPMENT OF FLOATING-BED SCRUBBERS. Chem. Eng. Progr. Symp. Ser., 57(35):51-54, 1961. 6 refs.

Aluminum is produced by the electrolysis of alumina dissolved in an electrolyte consisting of cryolite and other fluoride salts. The reduction process is carried out in cells called pots. During operation of the pots, fluoride-bearing fume, gaseous hydrogen fluoride, carbon oxides, sulfur dioxide, and particulate matter such as alumina, carbon, and tar are released from the pots. Containment of these materials has been a problem in wet scrubbers with grids or other fixed packing and impingement surfaces because the surfaces requiring the most wash receive the least. Cleaning problems are severe when the gas contains either tar particles or tar-coared solids. Floating-bed scrubbers eliminate these problems by virtue of a self-cleaning device. Gas is passed upward through a bed of light spheres, increasing liquid hold-up and sphere buoyancy. As a result, the spheres are free for rotational movement and for movement in relation to each other. High gas turbulence is set up in the bed when the upward flowing gas contacts the descending liquor. The effect is intimate mixing of gas and liquor to promote a hard scrubbing action. About 95% removal of fluorides at pressure drops of 3 1/2 to 4 in. water gauge was obtained in pilot studies of scrubbers containing polyethylene spheres. Other proven application of the floating-bed scrubber are treatment of aluminum-fluoride converter tail gas to remove silicon tetrafluoride and treatment of magnesium chlorinator tail gas to remove silicon tetrachloride.

17463

Hoeke, Bert and Horst Arnim Wittbold

WASH SOLUTION FOR PURIFYING FLUORINE-CONTAINING WASTE GASES IN ALUMINIUM INDUSTRY. (Waschloesung zur Reinigung fluorhaltiger Abgase in der Aluminiumindustrie). Text in German. Wasser Luft Betrieb, 14(1):24-29, Jan. 1970. 7 refs.

The separation of fluorine compounds and dust from waste gases of aluminum plants was studied in the laboratory. A suitable scrubbing liquid was determined for the waste gas; the developing compounds had to be soluble to avoid crystallization in the dust collectors and on pipes. Four test series were carried out with a rotating wet collector. The fluorine compounds could be removed to a large extent with an alkaline scrubbing liquid. A slight dependence of the degree of efficiency on the pH value of the scrubbing liquid was observed. At pH 8 to 12, the gaseous fluorine compounds could be removed to a residual concentration of less than 0.5 mg/standard cu m. The salt content of the circulating scrubbing liquid increased in the course of the experiments to a maximum of 64 g salt/liter water. The fluoride content of the scrubbing water reached 7 g F/l. Maintenance of a pH of more than 10.5 and a salt content of less than 70 g/l helped to prevent any incrustations. This necessitated periodic replenishment of the spent scrubbing liquid by fresh water. The spent liquid was treated with aluminum salts to precipitate the fluoride in the form of kryolith. The dry precipitant contained between 48 and 51% F which could be reused. The sludge collecting in the circulating scrubbing liquid had a settling time of 2 hours. Flocculants did not reduce this settling time. The water content of the sludge was 98%.

17485

Molyneux, F.

CRYOLITE FROM FERTILISER WASTE GASES. (PART 1). Australian Chem. Process. Eng. (Sydney), 23(2):32-36, Feb. 1970. 23 refs.

Processes for recovering fluorine from the stack gases of plants making superphosphate fertilizers and phosphoric acid from rock phosphate are discussed. Rock phosphate is the

only important alternsource of fluorine to scarce feldspar; the fluorine is required for the manufacture of cryolite, which occurs naturally and in limited quantities only in Greenland and which is required for the manufacture of aluminum from bauxite. The gases evolved in these fertilizer manufacturing processes present a serious air pollution hazard; since they are corrosive, their control without recovery of valuable fluorine compounds presents a difficult maintenance problem. One recovery process now in use at a demonstration scale plant consists in absorbing the fluorine which is present as hydrogen fluoride in a bed of lump limestone at temperatures above the dew-point of the stack gas. The Moritz process for cryolite from superphosphate plants utilizes the hydrofluorosilicic acid obtained from the scrubber gases in the superphosphate manufacture. A method of making aluminum fluoride, with which the industrial manufacture of synthetic cryolite is normally integrated, uses fluorine values from the waste gases from phosphate rock acidulation. A new and more general process recently developed for production of (AlF3)(3H2O) and synthetic cryolite from phosphate waste gas depends on making treble superphosphate by the acidulation of phosphate rock with phosphoric instead of sulfuric acid; this is described in some detail. Fluorine recovery can be made to materially assist the economics of a phosphate or phosphoric acid plant. A general evaluation of all processes, including wet phosphoric acid manufacture, provides a figure of 0.15-0.2 lb fluorine per 1000 cu ft of gas, of which up to 50% could occur in the process effluent as H2SiF6.

18144

DUST CONTROL: SOLVING THE AIR POLLUTION PROBLEM. Agr. Chem., 24(6):15-17, June 1969. 7 refs.

When an air quality control region has been designated, the state involved must set standards for that region. States are beginning to take action against factories suspected of contributing to air pollution. Suspected violations in Montana led to an abatement conference at which the emission of fluorides by phosphate plants was investigated following complaints from local residents concerning nose, throat, and respiratory irritation and property damage to metal and glass. It was noted that fluoride emissions are an adjunct to the process used but that they could be reduced with a high degree of efficiency. Land configurations and prevailing winds added to the problem at one plant. The TVA has developed methods for detecting, measuring, and recovering process materials. In one system, dust is recovered from dry cyclones and slurried in dilute process liquor for return to the process. Other suggested systems recovered carryover from a nitric phosphate preneutralizer and dust in a granular fertilizer plant.

18536

Coufalik, F. and M. Odehnal

CONTRIBUTION TO POSSIBILITIES OF OBTAINING BYPRODUCTS IN THE PRODUCTION OF FERTILISER PHOSPHATES BY DECOMPOSITION OF PHOSPHATE ROCKS. (K moznostem ziskavani vedlejsich produktu pri vyrobe fosforecnych hnojiv rozkladem fosfatu). Text in Czech. Chem. Prumysl (Prague), 7(9):465-469, 1957. 20 refs.

The possibility of obtaining fluorine and rare earth elements from the production of citrate-soluble phosphate, and the dependence of the fluosilicate yield on the amount of sodium nitrate used in precipitation were studied. Results indicated that the best method of obtaining fluorine during production of citrate-soluble phosphate fertilizer is by the precipitation of sodium fluosilicate with sodium nitrate. Fluosilicate prepared in this way is as pure as the byproducts of superphosphate production. The addition of 12-20 parts of a solid precipitating agent per hundred parts of apatite yields 58 to 76% fluorine. However, the precipitation of fluosilicate during the production of mixed fertilizers is not advisable. Evidence is presented for the possibility of obtaining a concentrate of fluorine and rare earth elements by the preliminary precipitation of a solution of decomposed phosphate rock, followed by partial acidification of the precipitate with diluted nitric acid.

18641

Rapko, Anton, Ondrej Sabo, and Pavel Gubric

SELECTIVE TRAPPING AND RECOVERY OF FLUORINE FROM WASTE GASES. (Spusob selektivneho zachytavania a regeneracie fluoru z odpadnych plynov). Text in Slovak. (Assignee not given.) Czech. Pat. 121,428. 3p., Dec. 15, 1966. (Appl. May 17, 1965, 2 claims).

A method is described for the selective trapping and recovery of fluorine from waste gases emitted in the electrolytic process of the manufacture of aluminum. The waste gases are drawn off and washed in water to which aluminum hydroxide or metallic aluminum has been added, so that aluminum fluoride is gradually formed. When a concentration of 7-70 g fluorine per liter and 1-15 g aluminum per liter has been reached, cryolite is precipitated by the addition of sodium-aluminum solutions. In the example given, the waste gases are drawn off in such a way that the fluorine content is kept at a level above 200 mg/cu m. The gas flows through a pipe line where its temperature drops and then into absorption columns containing water to which an excess quantity of aluminum hydroxide or metallic aluminum scrap has been added. During absorption the concentration of the aluminum fluoride gradually rises. The untrapped sulfur dioxide can be retained in a second stage of washing, for instance, by washing in a lime solution. Cryolite is precipitated by the gradual addition of a sodium-aluminum solution to the absorbing acid, with intense stirring, until complete neutralization, i.e., a pH value of 6.5 to 7.0, is reached. The cryolite is then separated (by sedimentation), filtered, and annealed at 500-600 C.

18698

Erga, Olav, Sven G. Terjesen, and Adne O. Utvik

SELECTIVE ABSORPTION OF FLUORINE FROM THE GASES FROM ALUMINUM REDUCTION CELLS WITH VERTICAL SPIKE SODERBERG ANODES. In: Extractive Metallurgy of Aluminum. G. Gerard (ed.), Vol. 2, New York, Wiley, 1962, p. 83-96. 13 refs.

The principle of selective absorption of hydrogen fluoride from the burned anode gases as a control method for aluminum plants is examined. The device uses pure water as an absorbent and produces HF solutions in concentrations higher than 20 g/l (0.17 lb/gal) combined with absorption efficiencies up to above 99% and negligible absorption of sulfur dioxide. The efficiency of the device, which also serves as a dust separator and is essentially a sieve plate column modified to be self-cleaning within a continuous process, was tested in full-scale operation. (Author abstract modified)

18699

Schmitt, H.

THE FLUORINE PROBLEM IN ALUMINUM PLANTS. PART I. In: Extractive Metallurgy of Aluminum. G. Gerard (ed.), Vol. 2, New York, Wiley, 1962, p. 97-102. 11 refs.

Problems concerning the emission of waste gases containing fluorine in the operation of aluminum smelters and some con-

trol methods adapted to the plants are reviewed. Waste gases escaping from reduction cells contain fluorine as a gaseous compound, especially in the form of hydrofluoric acid, dusts, and aerosols. Based on tests of gases emitted from anodes, hydrocarbons emitted before the burner, i.e., methane, ethane, propane, and butane, were all combusted. Thus, there is no evidence of an emission of organic fluorine compounds either in the form of gases or condensates. Control equipment for an aluminum plant would consist of dust cyclones, an electrostatic precipitator, and scrubbers. Spray chambers to clean the air escaping from cell rooms are also considered. With this equipment, the absorption efficiency for fluorine in gas form amounts to 90%.

18826

Donovan, J. R. and P. J. Stuber

SULFURIC ACID PRODUCTION FROM ORE ROASTER GASES. J. Metals, 19(11):45-50, Nov. 1967. 15 refs. (Presented at the American Institute of Mining, Metallurgical, and Petroleum Engineers, Annual Meeting, Los Angeles, Calif., 1967.)

Feed gas requirements for the contact acid process and available roaster gases and their purification for acid plant use are examined. The contact process using a vanadium catalyst is the accepted technique for making sulfuric acid from sulfur dioxide gases. Major features of this process are outlined. Optimum SO2 concentration in a conventional metallurgical type contact plant is approximately 7.0-7.5% by volume. As SO2 concentration decreases, smaller fractions of the reaction heat are available to preheat incoming cold gases. At approximately 3.5-4.0% SO2, the acid plant is thermally balanced; any lower concentrations require the addition of external heat. At low SO2 concentrations, the amount of water vapor brought in may exceed stoichiometric requirements for acid formation and consequently reduce product acid concentrations below desired limits. To minimize this problem, the gas stream is cooled to condense excess water. If all product is wanted as 25% oleum, refrigerated gas cooling will be needed at concentrations below 7%. At the other extreme, if product wanted is 93% acid, one can operate at SO2 concentrations in the range of 3.5-4.0% without refrigeration. Maximum limits for objectionable impurities, such as chlorides, fluorides, arsenic, lead, mercury, selenium, dust, and sulfuric acid mist, at the acid plant are reviewed. The composition of gas coming from any roaster depends on the amount of excess air used and the roaster temperature. The magnitude of sulfur trioxide formation is largely determined by the roaster system, with excess oxygen, temperature, and presence of finely divided catalytic oxides as the critical variables. Gas cleaning and conditioning equipment, including the Peabody scrubber and a two-tower scrubbing system, are discussed.

18830

Homes, John T., Lowell B. Koppel, and Albert A. Jonke

FLUIDIZED BED DISPOSAL OF FLUORINE. Ind. Eng. Chem. Process Design Develop., 6(4):408-413, Oct. 1967. 16 refs. (Presented at the American Chemical Society, National Meeting, 152nd, New York, Sept. 1966.)

A fluidized bed process developed for the disposal of fluorine, using activated alumina as the reactive solid and a potassium iodide scrubber, was over 99.9% effective in the removal of fluorine from a gas stream and utilized the activated alumina to near the theoretical conversion. It has capability for high fluorine disposal rates and produces a free-flowing solid product for waste disposal. A factorial experiment was used to determine that increasing temperature (300-400 C), increasing ratio of bed depth to diameter (3:6), and decreasing particle size (399-183 micron) significantly increased the capacity of activated alumina for fluorine removal. Changing the fluorine concentration from 5 to 75 volume % or the velocity from 1.25 to 1.65 times the minimum fluidizing velocity had no significant effect. A higher velocity (3.0) decreased the capacity slightly. Other solids reactants, less expensive than activated alumina, were given preliminary evaluation. Soda ash was especially promising. (Author abstract modified)

19177

Tripler, Arch B. Jr. and G. Ray Smithson, Jr.

A REVIEW OF AIR POLLUTION PROBLEMS AND CONTROL IN THE CERAMIC INDUSTRIES. Preprint, American Ceramic Society, Columbus, Ohio, 25p., May 5, 1970. 19 refs. (Presented at the American Ceramic Society Annual Meeting, 72nd, Philadelphia, Pa., May 5, 1970.)

Air pollution in the ceramic industry stems from the large amounts of dust and fumes which form at various processing stages. Five segments of the industry (glass, cement, mineral wool, asbestos, and brick) are considered. Prior to the analysis of the problems of each of these, eight basic control methods are listed along with comment on the application and approximate cost of each. The control methods listed are cyclones, scrubbers, fabric filters, electrostatic precipitators, adsorption, burning, stacks, and process modification. In the manufacture of glass three chief sources of air contaminants are batch drying of finely divided raw material prior to melting, gas or oil fired melting furnaces, and glass forming. The first of these presents only a dust problem. The furnaces, on the other hand, emit particulates and a gas combination representing both fuel products and the melt composition. Glass forming machines generate heavy smoke from vaporization of hydrocarbon lubricants. Both process modification and electrostatic precipitation are recommended. In the cement industry, dust is the major problem; dust reclamation is an an economic necessity. In spite of highly efficient collection, some of the dust escapes. Dustfall rates of 35 tons per square mile were recorded in areas adjacent to efficiently controlled kilns. A secondary problem is the effluent from the kilns which contain gaseous pollutants from the fuel and from the heating of the components. In the mineral wood industry, stack emissions containing condensed fumes from the molten material, sulfur dioxide, and fluorides as well as blow chamber and curing oven emissions consisting of fumes, oil vapors, binding agent materials, and up to 90% wool fibers must be contended with. The asbestos industry is faced with the twin threats of asbestosis and lung cancer as a result of asbestos dust in which a fiber thickness of 0.01 micron is fairly common. The current threshold limit value of 5 million particles per cu ft of air for a daily 8-hr exposure, 40 hrs per week is thought by some to be too high. The importance of controlling dust in the manufacture of silica brick was pinpointed in a Pennsylvania Dept. of Health report in 1939 revealing that 51.9% of 1035 workers examined had silicosis. The threshold limit value of airborne dust as set by the American Conference of Governmental Industrial Hygienists is a function of the silica content. In a dust containing 5% free SiO2, the TLV is 25 mppcf, but in a dust containing 45% free SiO2, the TLV is only 5 mppcf. For amorphous silica, the TLV is 20 mppcf.

19210

Matsuda, Norikazu

ABATEMENT OF AIR POLLUTION CAUSED BY FLUORIDE. (Fukkasuiso oyobi kakushu fukkabutsu niyoru taikiosen no taisaku). Text in Japanese. Kogai to Taisaku (J. Pollution Control), 6(7):509-514, July 15, 1970.

Sources of fluoride pollutants include aluminum refining and phosphate fertilizer, brick, glass, glass-fiber, steel, and cement manufacturing. Fluorides emissions from an aluminum refinery and a phosphate fertilizer plant, both subject to large numbers of damage claims, are shown in a block diagram. Examples of fluoride pollution by the Showa Denko plants in Fukushima and Chiba and Sumitomo Chemicals in Ehime are presented. Regulations applicable to pollutant sources in Osaka and Fukushima Prefectures are noted. A common method of processing fluorine compounds is the use of caustic soda. Fluorine becomes sodium fluoride, which is subsequently converted to calcium fluoride by lime. In aluminum refineries, the recovery rate of fluorine by the method is over 99%. Exhaust gas, however, shows a recovery rate of only 60-70%, even in factories equipped with a recovery device. If the density at the source is lowered to several ppm, the use of chimnneys around 200-m high will reduce the ground concentration to .1 ppb. At present, the recovery of fluorides is accomplished by wet methods, which give rise to mists such as hydrofluoric acid. The efficient processing of the mist is a future problem. Since the demand for aluminum is predicted to be 2,000,000 tons in 1975, an increase in aluminum refineries is expected. In the process of construction, future refineries must be thoroughly evaluated for fluoride pollution.

19212

Hishida, Kazuo

AIR POLLUTION CONTROL EQUIPMENT FOR FLUORIDE AND FLUORIDE PROPERTIES. (Fusso kagobutsu no seijo to sono jogai shisetsu). Text in Japanese. Kogai to Taisaku (J. Pollution Control), 6(7):521-530, July 15, 1970.

Guidelines issued by a local government recommend that processing plants choose economical and practical installations for purifying exhaust gas. A guideline for plants processing fluorides is described. A jet scrubber or a spray tower is recommended for cleaning by water. The standards for fluoride concentration in plants are 15 ppm at the maximum and 10 ppm on the average. After a detailed description of the general properties of fluorides including hydrogen fluoride, hydrofluoric acid, silicon fluoride, and hexafluoro silicic acid, their effects on health are reviewed, together with the maximum permissible concentration of threshold values. A 3-stage floating-bed type of wet scrubber, which is employed by a hydrogen fluoride manufacturing plant in Tokyo, is schematically illustrated. Also described are principles of removing or recovering fluorides, apparatus for absorbing fluorides, anticorrosive materials for the apparatus, processing of the water used to remove fluorides, re-use of the cleaning water, and the use of alkaline solutions for cleaning. Unit operations in the plant, which give rise to fluoride pollution, are tabulated. In addition, various local government standards for harmful gases and particulates are noted.

19487

Knapp, Lester L. and Clayton C. Cook

TREATMENT OF GASES EVOLVED IN THE PRODUCTION OF ALUMINUM. (Aluminum Co. of America, Pittsburgh, Pa.) U. S. Pat. 3,503,184. 3p., March 3, 1970. 5 refs. (Appl. March 7, 1968, 5 claims).

A process for removing hydrogen fluoride and finely divided solids from gas evolved in the electrolytic production of aluminum entails passing the gas stream upward for 0.25 to 1.5 sec through a 2- to 12-in. bed of finely divided alumina particles. The hydrogen fluoride is sorbed by the alumina particles and the finely divided solids are entrapped in the fluidized bed, which contains 50 to 150 pounds of alumina per pound of hydrogen fluoride. The alumina particles containing hydrogen fluoride are removed from the bed and fed to the fluoride baths of electrolytic cells. The gas stream leaving the bed is passed through bag filters on the surfaces of which any remaining finely divided solids and alumina particles small enough to be carried upward are deposited. The average residence time of alumina particles in the bed is 2 to 14 hrs.

19571

Berindan, Cornelia

ATMOSPHERIC POLLUTION INTERRELATION AND GREEN SPACES AS A PROTECTIVE PRINCIPLE OF INDUSTRIAL TOWNS. (Interrelation pollution atmospherique et espaces verts en tant que principe protecteur des villes industrielles). Tribune CEBEDEAU (Centre Belge Etude Doc. Eaux), no. 301:143-153, July-Sept. 1969. 59 refs. Translated from French. Belov and Associates, Denver, Colorado.

The protection of residential areas from air pollution due to industrial sources, by means of green plantings, is discussed. Plants intended for such protective zones should be resistant species and they should act on the atmosphere. The pollutants known for their phytotoxic properties are presented in tabular form. The action of plants on air polluted by dusts consists of decreasing the wind speed, collecting the dust on the leaves, and acting on the local air movement. The plants found to be resistant to pollutants are also listed in tabular form. The retention of sulfurous gas, fluorine, hydrogen sulfide, and nitrogen oxides has been established. A correlation between the type and concentration of the pollutant and the degree of plant resistance is needed when managing green spaces for sanitary protection. For each situation, the degree of toxicity of the pollutants should be known in order to choose species with a specific resistance. Plantings with an aerated structure, obtained by grouping wind breaks or rows of trees, retain dusts and gaseous pollutants better than compact areas. Methods which are recommended for determining the form of future protective zones include zoning the values of pollutants obtained by ground studies, mathematical processes based on the laws of pollutant dispersion, and graphic processes.

20436

Vaillant, G.

THE BATTLE AGAINST AIR POLLUTION IN THE FERTILIZER INDUSTRY. (La lutte contre la pollution atmospherique dans l'industrie des engrais). Text in French. Inform. Chim. Numero Spec., 69(43): 63-66, 69, Dec. 1966. 10 refs.

Sulfuric acid is widely used in the production of ammonium sulfate, superphosphates, phosphoric acid, potassium sulfate, and other fertilizers. The oxidation reaction is never complete and sulfur dioxide and sulfur trioxide are present in concentrations of 0.1 to 0.2% in the waste gases. Dry methods of their purification are briefly described; the wet methods involve scrubbing with an alkaline aqueous solution and utilize different reactions to recover either pure S or definite S compounds, such as sulfates or mixtures of sulfites and bisulfites. A wet method for recovery of ammonium sulfate utilizes the overall reaction: 2SO3H(NH4) + SO3(NH4)2 + 2H2SO4 yields 2SO4(NH4)2 + 3SO2 + 3H2O. The nitrogen- bearing fertilizers are produced by neutralization of nitric acid by the corresponding base. This acid is obtained by oxidation of ammonia. The air-pollution is due to incomplete oxidation of the intermediately formed nitric oxide to nitrogen dioxide and to incomplete dissolution of NO2 in water, so that the waste gas contains 0.2 or more % NO. Present day methods of their purification are not efficient and uneconomical. Natural phosphates used in the production of phosphor-bearing fertil-

izers contain 3 to 4% fluorine in the form of CaF2, which is liberated as HF or as SiF6H2 when the phosphates are treated by an acid. A method of removal of F compounds from the waste gases developed in France is described in some detail.

20857

Crocker, Burton B.

PREVENTING HAZARDOUS POLLUTION DURING PLANT CATASTROPES. Chem. Eng., 77(10):97-102, May 4, 1970. 5 refs.

A plant handling toxic materials must plan to prevent hazardous pollution during sudden and unexpected occurrences such as equipment malfunction, power failure, failure of cooling water, fire, flooding, and thick fogs which can lead to high ground-level concentrations. The necessary provisions, which will vary from one plant to another, are illustrated by the example of a plant in which hydrocarbon liquids are reacted in the presence of anhydrous hydrogen fluoride. To prevent high ground concentrations in the absence of thermal lift, provisions were made to keep the flare stack ignited by installing flare tips and pilots suitable for operation in hurricane winds. A flare-ignition system remotely operated in conjunction with a flare-flame-monitoring system warns the operator of flame failure. Reliability of the watercooling system on the HF recovery column is insured by the presence of three water-cooling pumps with suitable automatic controls, and a device to cut off the flow of process heat to the reboiler whenever there is no cooling-water flow. An oversize fluoride scrubber handles larger then normal flows of HF through the vent line. Fire hazards are reduced by insulating all vessels containing HF. To protect against excess pressure in the storage tank, it is equipped with a pressure relief valve venting into the common HF manifold leading to the drowning towers and flare stack.

21034

Molyneux, F.

CRYOLITE FROM FERTILISER WASTE GASES. Australian Chem. Process. Eng. (Sydney), 23(3):29,31,33,35,37,39, March 1970. 27 refs.

The performance of the venturi jet scrubber as used in the treatment of effluent gas from phosphate rock acidulation is analyzed. Due to the corrosive nature of the gas, the simple construction of this unit enables it to be fabricated out of plastic or other non-corrosive materials. Theoretical and experimental performance characteristics are determined for fluorine recovery. Average fluorine recovery was 97%. This type of control device may be applicable to the recovery of aluminum trifluoride and synthetic cryolite from phosphate fertiliser and aluminum refining industry.

21795

Teworte, W.

REDUCTION OF EMISSIONS IN METAL FOUNDRIES AND REFINISHING PLANTS. (Emissionsverminderung in Metallhuetten und Umschmelzwerken). Text in German. VDI (Ver. Deut. Ingr.) Ber., no. 149:260-273, 1970. 12 refs.

Although the non-ferrous metal industry is not a primary polluter of our environment, it is nevertheless confronted with the problem of reducing the sulfur dioxide, fluorine and dust emissions. The SO2-containing gases are used for the production of sulfuric acid; the so-called Bayer Contact Process with intermediate absorption is used for this conversion. A large-scale plant has gone into operation and the price of the sulfuric acid obtained with this method is up 1 to 2%. Fluorine emissions are usually drawn off by an exhaust system at the point of origin and scrubbed out of the waste gases. Dust with a high salt content (two thirds NaCl and KCl) as well as extremely fine particles containing grease and soot, is produced in aluminum plants. It is separated by cooling the 550 C flue gases in 4 cooling chambers to 150 C. A bag-type cloth filter consisting of 7 chambers and made of felt is used for dust collection. The filter is cleaned by a reverse air jet. Zinc alloy is increasingly processed by the imperial-smelting method plants which leaves a waste gas free of SO2. In copper and lead smelting plants electrostatic precipitators or bag filters are primarily used for waste gas cleaning. They are usually preceded by cyclones. Emissions due to metal recovery from old cables have not yet been satisfactorily reduced. Of the 70 plants of this kind existing in England and Wales, 60 use afterburners, while 9 operate with wet scrubbers.

22040

Teller, Aaron J. and Edward S. Wyatt

GAS SCRUBBER APPARATUS AND PROCESS. (Wellman-Lord, Inc., Lakeland, Fla.) U. S. Pat. 3,505,788. 4p., April 14, 1970. 2 refs. (Appl. May 23, 1968, 9 claims).

A gas scrubbing apparatus for recovering foreign materials, particularly fluoride gas and particulates, from a carrier gas is described. The carrier gas and foreign material are introduced tangentially into a vertical cylindrical recovery zone into which a washing liquid is radially sprayed. The foreign material is captured in a slurry and discharged. The gas then passes into a packed bed and second washing liquid to further remove contaminants. The bed is packed with a material having a nonadhering surface and a high free volume. The carrier gas then passes through another packed bed to remove entrained liquid. The advantages of this system over previous ones include low cost, fewer pieces of equipment, and no deposition of solid buildup. (Author abstract modified)

22484

Jewell, John P. and Burton B. Crocker

CONTROL OF FLUORIDE EMISSIONS. Vanderbilt Univ., Nashville, Tenn., School of Engineering, Tennessee Stream Pollution Control Board, and Tennessee Dept. of Public Health, Proc. Conf. Environ. Water Resources Eng., 8th Ann., Nashville, Tenn., 1969, p. 211- 228. 21 refs. (June 5-6.)

Fluoride compounds released to the atmosphere may be particulate, gaseous, or a mixture of the two. Solic particulate fluorides are usually released from handling operations which generate dust. Hoods or enclosures to contain or collect the particles and bag filters are desireable recovery devices. There are several methods for controlling gaseous fluorides including injection of ground limestone dust into the gas stream and wet scrubbing. Most installations for controlling gaseous fluoride emissions have involved absorption in water. Packed towers and spray towers are generally used for this purpose. One method of sizing water scrubbers is to obtain an idea of the number of transfer units needed to get from the maximum fluoride concentration in the inlet gas to the desired concentration in the outlet gas. Venturi scrubbers waste power when only gaseous fluorides are to be collected, but they may be the most economical multi-purpose scrubbers when a mixture of gaseous and particulate fluorides must be collected. It is recommended that the effluents be sampled and monitored to determine the operating efficiency of control equipment. Several sampling techniques are discussed.

22598

Karbe, K.

FLUORIDE EMISSION FROM FERTILISER PRODUCTION. Chem. Engr. (London) 46(7):CE268, Sept. 1968.

In general, the crude phosphates that are used as starting material for the production of fertilizers and phosphates contain 3-4% fluorine compounds. In the preparation of the fertilizers and phosphoric acid, the natural phosphates are decomposed by treatment with acids or by thermal decomposition processes. All methods of decomposition produce fluorine compounds as air contaminants, the thermal processes emitting the compounds as both gases and particulate aerosols. Dry and wet methods are available for purifying exhaust gases from fertilizer production. In the dry methods, hydrogen fluoride is absorbed by chalk or limestone with formation of calcium fluoride. Efficiency is 95%. In the wet methods, the gases are washed with water to convert hydrogen fluoride and silicon tetrafluoride to hydrofluoric and hydrofluosilicic acids, respectively. Removal efficiency of the wet methods is generally better than 90% and can be greater than 98%. Difficulties arise due to the conversion of silicon tetrafluoride to silicon dioxide, which can cause plant blockage. In Germany, exhaust gas emissions from new fertilizer plants cannot exceed 50 mg Fl/cu m.

22853

Cochran, C. N., W. C. Sleppy, and W. B. Frank

FUMES IN ALUMINUM SMELTING: CHEMISTRY OF EVOLUTION AND RECOVERY. J. Metals, 22(9):54-57, Sept. 1970. 7 refs. (Presented at the TMS-AIME Annual Meeting, 1970.)

Traces of gaseous and particulate fluoride must be removed from the effluent of aluminum smelting cells. Fluoride emission, both particulate and gaseous, increases with increase of temperature and decrease of bath ratio and aluminum oxide content. Hydrogen fluoride from reaction of moisture with aluminum fluoride- containing bath species increases with increasing partial pressure of H2O. The water vapor originates from the atmosphere, from constitutional water or water adsorbed on the aluminum oxide or from burning of hydrogen or hydrocarbons from the anodes. The particulate is removed by electrostatic precipitators, mechanical precipitators, scrubbers or bag filters. Gas scrubbers or adsorption on aluminum oxide are used for removal of HF. Adsorbing HF on aluminum oxide as a chemisorbed monomolecular layer permits recovery of the sorbed fluoride and the direct return of the fluoride to the pot. The chemisorbed fluoride is initially amorphous but forms aluminum fluoride upon heating. Physically adsorbed HF (in contrast to the chemisorbed layer) is re-evolved as HF on adding the recovery product to the pot. Thus, the fume removal process should be limited to the chemisorption reaction. Efficiency of HF recovery with aluminum oxide increases as fume concentration increases and the ratio of recovery product to pot feed increases. (Author abstract)

22913

Public Health Service, Raleigh, N. C., National Air Pollution Control Administration and Manufacturing Chemists Association, Washington, D. C.

ATMOSPHERIC EMISSIONS FROM WET-PROCESS PHOSPHORIC ACID MANUFACTURE. NAPCA Pub. AP-57, 86p., April 1970. 39 refs. CFSTI: PB 192222

In 1966, the production of wet-process phosphoric acid, expressed as P2O5, was approximately 3.5 million tons. Much of this was produced as 54% P2O5, and virtually all of it was used to produce various phosphate fertilizers. Fertilizers are produced by treatin phosphate rock with wet-process phosphoric acid to form triple super-phosphate, TSP, or by reacting phosphoric acid with anhydrous ammonia to form ammonium phosphates, especially diammonium phosphate, DAP. The emissions of most concern are fluoride compounds liberated from the phosphate rock by sulfuric acid: hydrogen fluoride, silicon tetrafluoride, and some products of reaction and decomposition of the latter. Vapor scrubbing is universally employed to control emissions, while specific devices used for control include venturi scrubbers, impingement scrubbers, and various kinds of spray towers. The major source of gaseous fluoride emissions in wet-process phosphoric acid plants is the digester. Emissions and methods of emission control are discussed in detail, and sampling and analytical techniques are summarized. Wet-process phosphoric acid manufacture is described, as well as growth of the industry.

22923

Hughes, Everett C.

VOLATILE FLUORIDE RECOVERY. (Standard Oil Co., Cleveland, Ohio) U. S. Pat. 2,440,542. 3p., April 27, 1948. 7 refs. (Appl. July 17, 1942, 18 claims).

Volatile fluorides, such as boron fluoride and hydrogen fluoride, used in catalytic operations are discharged in admixture with themselves or with hydrocarbons. While the fluorides can be separated by fractional distillation and condensation, this method is expensive and in many cases not profitable. In contrast, the fluorides can be conveniently recovered with relatively little expense by exposing gas containing them, in countercurrent flow in a tower, to dihydroxyfluoboric acid. Part of the fluoride is absorbed at about 27-55 C while the remainder is liberated by raising the temperature of the acid to 120 C or above. As an example, gas containing hydrogen fluoride at 1 atm was subjected to absorption at 35.2 C, and 91% by weight of HF was absorbed. By raising the temperature to 170 C, 95.7% by weight of HF was recovered. The acid is recycled to contact fresh incoming gas.

22943

Hammond, Rolt

ELIMINATING DUST IN CHEMICAL PLANT. Chem. Age, (New York), vol. 77:431-433, March 9, 1957.

Among new equipment for eliminating dust from chemical plant flue gases is a multi-wash collector that removes submicron particles with maximum efficiency. The collector comprises a cylindrical stainless steel tower with six and one-half vaned impingement stages. An entrainment separator placed above the units forms a seventh tier. Air enters the tower just below its conical base, which acts as a wet cyclone to collect the heavier particles upon entry. A water curtain descending from the top of the tower combines with spray and impingement to envelop the particles rising with the air, carrying them down into the cone and out of the collector. When most of the dust is above the submicron range, collectors with fewer stages are employed. These collectors are equally effective on both soluble and insoluble dusts and on soluble gases. For the removal of gaseous contaminants such as hydrogen sulfide, sulfur dioxide, hydrochloric or hydrofluoric acid vapors, alkaline solutions are added to the recirculated liquid. For the 0.1 to 5 micron particles found in pharmaceutical and bacteriological work, an esparto grass-based paper filter with asbestos fibers has an efficiency of 99.95%. This filter can be accommodated in a very small place. A reverse-jet type filter has proved very efficient for vaporized silica of 0.6 micron and less. Electrostatic precipitators are used to remove dust and

fumes from pyrite roasters, sulfuric acid mist from wet catalyst sulfuric acid plants, and sulfuric acid mist from coal roaster gases. Static rectifiers for the precipitators are available that dispense with the high-tension connections formerly required. Alternating current is rectified and used without high-frequency effect on the wave-form, as in the case of mechanical rectifiers.

23182

Purvance, W. T.

ATMOSPHERIC POLLUTION CONTROL. Chem. Eng. Progr., 55(7):49-53, July 1959. (Presented at the American Institute of Chemical Engineers Meeting, Salt Lake City, Utah, Sept. 1958.)

The development of measures to control fluoride emissions from a Utah steel plant which had caused damage to local animals is described in detail. The open hearth shop and sintering plant were the major sources of emission, while the locally-mined iron ore was the raw material responsible for the greatest quantity of fluorine. On the basis of extensive pilot plant testing, limestone was added to the sintering mix, and equipment for cleaning sintering waste gases were installed, including facilities for injecting pulverized limestone into the gas stream, a battery of mechanical cyclones, and an electrostatic precipitator. A reduction of 96% in fluoride emissions from this source was thus achieved, with important savings from recycling the waste gas. For the open hearth operations, it was decided to collect and blend the waste gas effluent from all the furnaces in a collector main flue, from where it is passed to individual precipitator units. Clean gases are discharged into existing stacks; hydrated lime is the reactant in the process. The major problems encountered were handling of the collected dust, control of gas moisture, and furnace pressure control. The $9 million cost of the entire control program from research through operation is viewed as part of the cost of using Utah iron ore. The equipment is considered unique in that extremely large volumes of gas are continuously undergoing chemical treatment and final cleaning while the final collected product is disposed of.

23310

Varlamov, M. L., Ye. L. Krichevskaya, A. A. Ennan, L. M. Kozakova, and G. A. Manakin

ACOUSTIC COAGULATION OF MIST CONTAINING FLUORINE COMPOUNDS. I. (Akusticheskaya koagulyatsiya tumana, soderzhashchego soyedineniya ftora. I). Text in Russian. Zh. Prikl. Khim., 34(1):78-84, 1961. 28 refs.

Removal of fluorine compounds from mist was increased from 42-69% to 80-95% by inducing acoustic coagulation through application of 16.5-kHz sound at 153-155 dB. Degree of removal was significantly affected by the concentration of the mist; increasing moisture content from 15 to 120 g/cu m upgraded removal from 73 to as high as 95%. With constant moisture content, the degree of removal increased with initial fluorine concentration and with the duration of the sonic treatment. Tests at a granulated superphosphate plant showed precipitation of 87% of the fluorine in exhaust gases after 3 seconds of sonic treatment; fluorine content was reduced from 0.18 to 0.025 g/cu m directly within the sonic-treatment tube without auxiliary mechanical precipitation.

23370

Boehlen, B.

FLUORINE EMISSION AT ALUMINIUM WORKS. Chem. Engr. (London), 46(7):266-268, Sept. 1968.

The electrolysis of fused alumina, with cryolite as the fluxing agent and electrolyte, gives rise to waste gases with a fluorine content. The method by which the electrolysis furnaces operate requires two separate waste-gas purification systems, one for interception and conveyance of waste furnace gases to a purification plant, and one for cleaning fluorine-contaminated air used for ventilation of furnace room premises. The purification processes for both systems are described briefly, and the problems are reviewed. Because of the large quantities of waste air involved, considerable costs are incurred to provide the power required for ventilation, the large quantities of scrubbing water, and the pumps to convey the water; the presence of corrosive hydrogen fluoride creates added difficulties. The possibility of replacing cryolite by electrolytes which do not contain fluorine is recommended for future research.

24033

Damon, W. A.

THE CONTROL OF NOXIOUS GASES AND FUMES DISCHARGED FROM INDUSTRIAL UNDERTAKINGS. World Health Organization, Copenhagen (Denmark), Regional Office for Europe, Proc. Conf. Public Health Aspects Air Pollution Europe, Milan, Italy, 1957, p. 103-130. 26 refs. (Nov. 6-14.)

The greatest contribution to air pollution arises from the combustion of fuel for domestic and industrial purposes and from motor traffic. Its damaging effects include injury to plants, deterioration of property, and possible or proven hazards to the health of humans and animals. British air pollution legislation is embodied mainly in three Acts of Parliament: the Alkali etc. Works Regulation Acts, first enacted in 1863; the Public Health Acts, 1936; and the Clean Air Act, 1956. Evolution of the chemical industry has caused a variety of changed and new pollutants. Fluorine compounds can be washed in alkaline solutions, followed by electrical precipitation. The escape of SO2 from the exits of sulfuric acid plants depend on the efficiency with which the the process is conducted. In four stage contact plants burning brimstone, recourse to scrubbing the exit gas with either soda or ammonia may be necessary. Power stations remove SO2 from waste- fuel gases by scrubbing with slightly alkaline water. Sulfur dioxide arising from the roasting of copper as in the production of iron oxides is normally absorbed by passage through towers packed with limestone. Hydrogen chloride may be recovered at a useful strength by arranging a counter current series of absorbers. Hydrogen sulfide may be scrubbed with caustic soda to produce sodium sulfide; it may be absorbed by passage through hydrated iron oxide which can be regenerated to produce spent oxide containing up to 50% sulfur; or it can be stripped out by means of a solvent and regenerated in concentrated form for treatment in a Claus Kiln. Gases containing chlorine may be scrubbed with an alkaline solution or by contact with milk of lime; passage through a tower packed with scrap iron is also effective. Nitrogen peroxide may be recovered in the form of nitric acid by water washing; but for every three molecules of nitrogen peroxide thus absorbed there is evolution of one molecule of nitric oxide which must be reoxidized to nitrogen peroxide.

24110

Berly, Edward M., Melvin W. First, and Leslie Silverman

RECOVERY OF SOLUBLE GAS AND AEROSOLS FROM AIR STREAMS. Ind. Eng. Chem., 46(9):1769-1777, Sept. 1954. 18 refs.

High efficiency absorpiton of soluble or reactive gases was obtained with wetted fiber beds. Wetted fibers were five to 10 times more efficient than Raschig rings or Berl saddles, compared on the basis of equal volumes. When compared on the basis of weight of packing, 1 pound of 78-micron-diameter saran fibers was 75 times more effective for the absorption of hydrogen fluoride gas than 1 pound of 1/2 inch Berl saddles. In addition to hydrogen fluoride gas, cleaning efficiency for sulfuric acid and ammonium bifluoride mists, ammonium bifluoride and aluminum chloride fumes, and silica, tale, and atmospheric dusts was investigated. High efficiency collection (greather than 99.9%) generally required the addition of a droplet eliminator composed of a 1- to 2-inch depth of dry fibers less than 5 microns in diameter. Although absorption of the gas was complete, a significant quantity of fluorides passed the scrubber in the form of fine (less than 10 micron) mist droplets formed from condensation of hydrogen fluoride gas in the humid atmosphere of the scrubber or from fine droplets formed by the sprays. When gas streams containing inert particles were treated, the absorbing stages were protected from fouling and plugging by the use of an impingment device such as a Neva-Clog screen as a prefilter. Over-all resistance of the scrubber was proportional to the flow rate. For gas flows of 200 cu ft/min, sq ft of scrubber face area, high efficiency scrubbing of gas and submicron particulate matter was obtained with resistances not exceeding 6 inches of water gauge For atmospheric pollution control of stack gas, emissions resistances less than half this may be adequate. (Author summary)

24116

McCabe, Louis C.

ATMOSPHERIC POLLUTION. Ind. Eng. Chem., 47(8):95A-96A, Aug. 1955. 1 ref.

In the electrolytic reduction of alumina, oxygen libertated in the cryolite bath combines with the carbon of the node to produce carbon dioxide. As the CO2 rises through the blanket of alumina covering the electrolytic cells, small amounts of alumina dust and fluorides are entrained. On striking the air the fluorides are hydrolyzed, in part, to hydrogen fluoride gas. Heat generated in the reduction process requires that effective ventilation be maintained to provide satisfactory working conditions in the potrooms, but the high velocities of an induced draft pick up some of the fine dust from the top of the pots. The collecting systems consist basically of a dry type dust separator, an induced draft fan, and a wet scrubber. A typical system of this type uses a dry dynamic precipitator exhauster that is so designed that the dust is separated from the main gas stream within the fan by means of specially shaped blades and a separate outlet in the scroll. The main gas stream, containing some fine dust, is discharged directly to an open tower type scrubber of redwood construction with suitable spray headers. At one large plant, the basic system has been supplemented by an electrostatic precipitator. Fumes generally can be controlled by accurate regulation of the temperature of the bath, the rate of firing, and the amount, method, and type of flux used.

24117

Tarbutton, Grady, Thad. D. Farr, Thomas M. Jones, and Harry T. Lewis, Jr.

RECOVERY OF BY-PRODUCT FLOUORINE. Ind. Eng. Chem., 50(10):1525- 1528, Oct. 1958. 14 refs. (Presented at the American Chemical Society, 132nd Meeting, Symposium on Fluorine Chemistry, New York, Sept. 1957.)

Basic information was obtained for developing practical methods for recovering fluorine compounds from effluent gases from phosphate processes and converting this fluorine into useful end products. The study included experiments with gases discharged from kilns for nodulizing rock phosphate and from a demonstration furnace for the manufacture of calcium metaphosphate fertilizer. On the assumption that the fluorine in nodulizing kiln gas was present only as hydrogen fluoride, initial work on recovery of fluorine from dilute gases was directed toward a solid-bed system for absorbing the fluorine. In a quantitative test, two absorption beds of porous sodium fluoride were connected in series --the first, in a copper tube at 300 C, for absorption of sulfur trioxide, and the second, in a silver tube at 100 C, for absorption of the hydrogen fluoride liberated from the first. Later it was found that much of the fluorine was present as silicon tetrafluoride, and emphasis was shifted to other methods of recovery. A method partially developed by TVA for preparing aluminum fluoride from ammonium fluoride solutions containing phosphoric acid involves precipitation of ammonium hexafluoroaluminate, which is then decomposed by heat to leave a residue of aluminum fluoride; the volatilized ammonia and ammonium bifluoride are recycled. An alkaline and an acid method for preparing cryolite were also evaluated. In the alkaline method, solutions of the reactants are heated to boiling and mixed, and the hot basic solution is acidified to the phenolphthalein end point by slowly adding carbon dioxide. In the acid method, a slightly acidic solution of ammonium fluoride is mixed with a solution of sodium and aluminum salts without heating.

24333

McCabe, Louis C.

ATMOSPHERIC POLLUTION. Ind. Eng. Chem., 43(8):83A-84A, 86A, Aug. 1951. 2 refs.

At Trail, British Columbia, essentially 100% gas is recovered from 1% sulfur dioxide zinc roaster gas through the use of 30% ammonia as the absorbent. The sulfur shortage is causing more than one large consumer of coal to look into the possibility of recovering sulfur from stack gases. A process patented by Simon-Carves entails control of the composition of the liquor in the scrubber by an electrical vapor pressure recorder. In the first pilot plant, the concentration of SO2 in the exit gas was found regularly to be as low as 0 0005% which corresponded to the removal of 99% of the SO2 in the flue gas. The flue gas at the Battersea power station in London is washed with large volumes of river water to which chalk has been added, so that the calcium sulfate formed remains in solution and can be discharged into the river. Another paper to be presented at the XII International Congress of Pure and Applied Chemistry (September 1951) pertains to atmospheric pollution by fluorine compounds in Rotterdam and its environs.

24355

Hignett, T. P. and M. R. Siegel

RECOVERY OF FLUORINE FROM STACK GASES. Ind. Eng. Chem., 41(11): 2493-2498, Nov. 1949. 5 refs.

More than 90% of the fluorine present in the stack gases from thermal processing of rock phosphate was recovered by absorption in a 4-ft bed of lump limestone. The calcium fluoride product contained 80-95% CaF2, which is in the range of comercial grades of fluorspar. In the pilot plant studies, the fluorine absorption coefficient was dependent on the rate of removal of the reaction product from the bed of limestone by screening. Temperatures in the range of 200-900 F were suitable for the process. Increasing the gas velocity in the range of 0.6 to 1.5 ft per sec increased the absorption coefficient but did not appreciably affect the percentage of fluorine absorbed.

Substantially complete recovery can be obtained by increasing the depth of packing to about 9 feet. (Author conclusions)

24683

INITIATIVE FOR WATER AND AIR POLLUTION CONTROL. (Initiative fuer Wasser-und Luftreinhaltung). Text in German. Wasser Luft Betrieb, 14(9):375-378, Sept. 1970.

The Nordrhein-Westfalen Program 1975 contains an outline of water conservation, air pollution, and refuse disposal perspectives for the next 5 years. Discussed are water conservation, river pollutio control, natural water pollution 1970 and 1975, waste disposal, air pollution control, new sources of pollution, current control of air quality, and noise control. Drinking water supply will be increase by increasing the capacity of water clearing installations, the water quality of the Rhine river and of its tributaries will be controlled by a number of automatic measuring stations; about 300 new biological clearing installations will be built. Controlled refuse dumps will be established for each 20,000 inhabitants; composting of refuse and incineration will serve larger population units. New air pollution measures are planned for Thomas steel converters, ore sintering plants, coke ovens, foundries, and steam power plants. New sources of pollution to be dealt with include the increasing number of atomic power plants being built and the tremendous growth rate of the chemical industry. Supervision of air quality will extend to fluorine, hydrocarbons, offensive sulfur and nitrogen compounds, dust concentration, chlorinated hydrocarbons, and oxidants. Noise pollution control will be concerned with the design and building of silent machines, motors and equipment, with improving insulation against noise, with a registration of sources of noise, and with noise control research

24834

Barber, J. C. and T. D. Farr

FLUORIDE RECOVERY FROM PHOSPHORUS PRODUCTION. Chem. Eng. Progr., 66(11):56-62, Nov. 1970. 9 refs.

When phosphate rock is processed to make various phosphate chemicals, fluorine in the rock is evolved as gaseous hydrogen fluoride, silicon tetrafluoride, or a mixture of these gases. Substantially all the fluorine must be removed to comply with Federal, state, and local pollution abatement regulations. TVA studies of fluorine recovery revealed that fluorine compounds can be readily removed by scrubbing the gases with slightly acidic aqueous ammonium fluoride. The hydrogen fluoride dissolves and reacts with ammonia in the aqueous solution to form ammonium fluoride. The silicon tetrafluoride dissolves in aqueous ammonium fluoride to form a solution of ammonium fluosilicate. Silicon and iron compounds are removed from the ammonium fluoride-ammonium fluoscilicate scrubber liquors by adding ammonia to raise the pH to 8-9; the fluosilicate decomposes, and precipitates of hydrated silica and iron hydroxide are separated from the ammonium fluoride solution. The silicon and iron contents of the filtrate will correspond to weight ratios F:Si02 and F:Fe203 well above the minimum values specified by the aluminum industry for cryolite and aluminum fluoride.

25038

Gartrell, Francis E. and James C. Barber

ENVIRONMENTAL PROTECTION--TVA EXPERIENCE. J. Sanit. Eng., Am. Soc. Civil Engrs. Div., 96(6):1321-1334, Dec. 1970. 7 refs. (Presented at the American Society Civil Engineers, Water Resources Engineering Meeting, Memphis, Jan. 26-30, 1970.)

Establishment of the Tennessee Valley Authority created a unified program that saw in the Tennessee Valley's water, land, minerals, and forests one interrelated set of opportunities for improving the living standards of the people in the region. Research on soil-fertilizer relationships, fertilizers, and fertilizer processes is conducted at the National Fertilizer Development Center. One water resource study which was undertaken at the Center involved determination of the conditions that give rise to excessive growth of nuisance weeds in a TVA reservoir, while another project involved determination of the amount of plant nutrients lost from land into both surface and ground waters. Two approaches may be followed in the development of fertilizers for the control of nutrient losses in streams; slow-release chemica compounds may be used as fertilizers, or the highly soluble fertilizer granules may be coated to retard their solubility in the soil. Various fertilizers are produced at the Center, and environmental control during their production is discussed. Electric furnace phosphoric acid production presents some particularly difficult pollution abatement problems. Production of fluoride by-products may be economical in some large electric furnace phosphoric acid plants or in plants where large amounts of fluorine are driven off during the phosphate ore heat hardening step. A modern ammonia plant is being constructed. Two of the 11 coal-fired power plants in the TVA system have cyclone furnaces, eight have dry bottom pulverized fuel furnaces, and one has a wet bottom pulverized fuel furnace. They all have essentially the same system for ash disposal. Research is being conducted on the remova of sulfur dioxide from power plant stack gases, including an ammoni scrubbing process, sorption by dry limestone, and limestone wet scrubbing. Waste heat for disposal has required a study of the effects of cooling tower discharge. Also, composting research is being conducted adjacent to the city's sewage treatment plant.

25135

Rossano, August T., Jr. and Michael J. Pilat

RECENT DEVELOPMENTS IN THE CONTROL OF AIR POLLUTION FROM PRIMARY ALUMINUM SMELTERS IN THE UNITED STATES. Preprint, International Union of Air Pollution Prevention Associations, 19p., 1970. 9 refs. (Presented at the International Clean Air Congress, 2nd, Washington, D. C., Dec. 6-11, 1970, Paper EN-16F.)

The alternative processes and equipment employed in the production of aluminum are described. Details of the types and relative magnitudes of pollutants emitted from both the prebaked and continuous anode type of electrolytic refining processes are briefly reviewed and illustrated. Air pollution regulations recently adopted by the Department of Ecology of the State of Washington are presented. These regulations stipulate the maximum permissible concentrations of fluorides in the ambient air surrounding an aluminum smelter and the maximum fluoride content of forage, both expressed on a time average basis. In addition, the regulations restrict the amount of particulate matter emitted. A brief resume of current efforts by industries to meet these new regulations is given. Engineering control measures being developed and tested include wet scrubbers, wet electrostatic precipitators and a new chemisorption technique involving a fluidized bed followed by bag filters. It is concluded that rapidly growing emphasis on the maintenance and improvement of air quality throughout the United States will serve to stimulate new and better technology for the control of emissions from primary aluminum smelters. (Author abstract)

25178

Teworte, W. M.

SPECIFIC AIR POLLUTION CONTROL ARRANGEMENTS AT NONFERROUS METAL WORKS. Preprint, International Union of Air Pollution Prevention Associations, 41p., 1970. 20 refs. (Presented at the Internationa Clean Air Congress, 2nd, Washington, D. C., Dec. 6-11, Paper EN-28B.)

Information on the cost problem and on the necessity for air pollution control technology in the field of non-ferrous metals production is presented. Their price, high in comparison with that of steel, is an incentive to developing any means of increasing the yield and, thus, to recovering the metals from flue dusts. Therefore, the center of air pollution control arrangements shifts to the side of extracting accompanying elements in the ores, auxiliary materials, and highly volatile compounds. The negative biological effects of a large number of metals require particularly effective arrangements for waste gas purification. More recent specific methods of air pollution control are illustrated by several examples. Fluorine emissions from the flux are fought in aluminum works by means of effective wet purification processes; dry absorption methods are also being tried. Fluorine levels of 0.5-1.5 ppb were detected even in industrial areas where there was no aluminum production at all. Waste gas purification at aluminum re-melting works presents a particularly difficult problem with regard to the extraction of very fine salt fumes. The utilization of the sulfur content in the non-ferrous metal ores is discussed in detail. Here, the solution to the economic problem of marketing a sulfuric acid, aptly called 'acide fatal' by Belgian smelting works, is as important as the solution to the process-technical problem. The latter was dealt with very successfully by means of the development of a double-contact process with intermediate absorption for roasting gases poor in sulfur dioxide. The final gases contain less than 0.5% of the SO2 charge. More and more processes favorable to air hygiene are being used by zinc metallurgy. Methods of recovery that cannot be controlled by waste gas technology, will be discarded. General and particular information is given on the cost problem of air pollution control. Frequently, the wrong conclusions are drawn from the fact that only 0.2% of the value of industrial production are required for direct steps, with secondary injurious effects, amounting to 1-2%, being prevented in this manner. Production at some works is hard hit by specific costs of 1-5% of the proceeds from sales. (Author abstract)

25195

Lindberg, Gosta

AIR POLLUTION CONTROL IN THE SWEDISH ALUMINIUM INDUSTRY. Preprint, International Union of Air Pollution Prevention Associations, 18p., 1970. (Presented at the International Clean Air Congress, 2nd, Washington, D. C., Dec. 6-11, 1970, Paper SU-24C.)

Aluminum metal is produced from aluminum oxide through an electrolytic reduction process at an elevated temperature (950-970 C) thereby generating atmospheric impurities containing gaseous and particulate fluorides. The polytoxic effect of even small amounts of fluorides on vegetation is well known and emitted gases from the process have therefore been carefully collected and cleaned in efficient scrubbing equipment. The smelter plant of AB Svenska Aluminiumkompaniet is located close to the town of Sundsval with 65,000 inhabitants. For the latest production stages it has been necessary, not only to clean the primary process gases, but also the huge volumes of ventilation air--at present amounting to 10 million cu ft/hr (6 mill cfm). The collection and cleaning system applied has an overall cleaning efficiency of fluorides exceeding 90%. Damage caused partly by fluoride emission from the older smelter plant on vegetation in adjacent regions has necessitated further dilution of released fluoride impurities. As a result of a combined meteorological and topographical study, 70-m (210 ft) high discharge stacks have been erected. As an instrument for vegetation contrrol in the smelter environment, a botanical study is recommended. Fluorine content determination of pine needles from a number of stations in the surrounding area has proved to be a method of considerable value in this respect. Sampling and analyses are made toward the end of the growing season. Isopleths for fluorides are obtained by combining testing stations with the same amount of fluoride content. The position of the curves yield information about the actual emission situation an the cleaning system efficiency. The isopleth positions have, however, changed somewhat from year to year-- even without changes being carried out at the plant installations. Meteorological conditions such as amount of rainfall, prevailing wind directions, and rate of inversion appear to be confusing factors when judging the effects of plant extensions or other changes affecting the fluoride emission. Amount of rainfall and wind direction has been measured for years. To study the rate of inversion a mast of 40 m (130 ft) has been erected and equipped with temperature recording instruments at different heights above the ground. Comprehensive meteorological and ecological investigations should be a significant part of the preparatory work when examining the possibilities for further extension of existing plants or the location of new plants. (Author abstract modified)

25433

GIANT FUME CATCHER STOPS FLUORIDE EMISSION. Chem. Eng., 65(4):66, 68, Feb. 24, 1958.

Measures taken to control fluorine-fluoride emissions from a steel mill's stacks are described. The emissions had been contaminating nearby grazing lands, and through ingestion and subsequent concentration in the bones and teeth of grazing cattle, had threatened the health of the herds and milk production. Major emission sources in the plant, which processes a relatively high-fluorine iron ore, where the sintering plant and open hearth section. The control method, suggested by the affinity of fluorine for calcium in animal bones, is based on the rapid gas-solid reaction between fluorine and calcium compounds (carbonate and hydroxide), to give calcium fluoride. Fluorine-containing gases are collected, calcium hydroxide dust injected into ducts, and fluoride particles removed in a 1-million cfm capacity cyclone-precipitator section. Powdered limestone injections in the sinter charge and effluent gases, and in the effluent gases from the open hearth furnaces, assist the process. The method removes about 96% of fluorine and fluorides in effluent, and represents a $9 million investment.

25523

Crocker, Burton B.

MINIMIZING AIR POLLUTION CONTROL COSTS IN AN OLD PLANT. Pollut. Eng., 1(1):30-31, Oct.-Nov. 1969.

One of the first steps in controlling air pollution is to determine the sources of contaminant emission, quantity, size, physical state and carrying medium of the pollutants. When contaminants are a by-product of a production operation, generation can be minimized by changes in operating conditions. Fluroine compounds released when some ores are heated frequently can be decreased if water vapor is eliminated from the atmosphere. If contaminant gases are handled by an exhaust fan, it may be possible to obtain some collection in the fan by adding a water spray at the inlet. In many

direct drying processes where the product is dried by direct contact with hot combustion gases on a one-pass basis, effluent can be reduced by recycling some of the flue gas to temper the incoming combustion gases. Cooling by radiation panels, finned surfaces, waste heat boilers, forced convection heat interchange, and direct spray cooling with water are all possible solutions. Questions concerning whether to use dry or wet collection are also cited.

25590

Larson, Gordon P.

A PROGRESS REPORT ON CONTROLLING ATMOSPHERIC POLLUTANTS. J. Air Pollution Control Assoc., 7(4):302-307, Feb. 1958. (Presented at the Air Pollution Control Association, 50th Annual Meeting, St. Louis, Mo., June 2-6, 1957.)

A review of the air pollution control activities in 1957 shows an impressive record of 6 million dollars expended in research, over 200 governmental agencies assigned some measure of responsibility for clean air in their communities, and annual sales in control equipment and engineering services in excess of 100 million dollars This article discusses the state of the art of controlling sulfur dioxide emissions from smelters and refineries; dust and fumes, particularly those produced by metallurgical processes; organic vapors and gases, including hydrocarbons; fluorides from aluminum and phosphate fertilizer plants; and the three basic engineering methods that can be applied to reduce aerosols, vapors, and gaseous contaminants. Tables are presented which classify various types of collectors and control devices in relation to the processes and emissions. They also show the great number of systems to be considered and some of the advantages and disadvantages of each device. To a large extent, most of these installations are custom engineered and built on the site. The costs cover a broad range. As indicated by recent health studies, there is need for maximum controls on all forms of pollution for which solutions are known. These studies also point up the need to develop control measures for hydrocarbon emissions from industry and motor vehicles.

25638

PROTECTION AGAINST IMMISSION. (Immissionsschutz). Text in German. Rheinisch-Westfaelischer Technischer Uberwach.- Verein E.V., Jahresbericht, 1969:38-41, 1969.

The five principles promulgated in the framework of an intensified air pollution control campaign by the state of Nordrhein-Westfalen and adopted also by the other West German states postulate that all polluters be identified and included in the pollution control program, that the atmosphere be kept as clean as possible and not as dirty as just about tolerable; that the costs of the program be born equally by all polluters so that no competitive advantages arise; that the polluters bear the cost of their pollution control measures and public funds be used only in special situations; and that air pollution control as a community responsibility requires the cooperation of all concerned. Thus, all polluters are subject to certification and must meet all prescribed maximal emission regulations pertaining to dust emission, SO2 emission, and other applicable regulations. Fluorine is emitted by brick factories in quantities between 30 and 300 mg/N cu m, by cupola furnaces in quantities between 4 and 280 mg N/cu m, by Siemens-Martin furnaces in quantities between 7 and 70 mg N/cu m, by fertilizer plants in quantities between 6 and 80 mg N/cu m and by plants manufacturing insulating wool in quantities between 0.4 to 3 mg N/cu m. Guidelines regarding the required height of smoke stacks, emissions by refuse incineration plants, supervision of pollutant concentration and emission of pollutants, control of emission by boiler plants, control of olfactory pollutants and of noise pollution are outlined.

25658

METHOD FOR THE REMOVAL OF FLUORINE FROM INDUSTRIAL GASES. (Research Corp., New York, N. Y.) Brit. Pat. 752,803. 6p., July 18, 1956. 1 ref. (Appl. Feb. 8, 1954, 7 claims).

A method is described for the removal of fluorine from industrial gases, which comprises adding comminuted lime to a stream of gases, subjecting the lime-containing stream to vortical action, skimming off a portion of the gas containing an increased concentration of particulate matter, and returning this portion to the stream to be subjected to vortical action. The separation of solid matter from the remaining portion of the gases may be effected by electrostatic precipitation. In its particular application ot the removal of fluorine from gases in a sintering machine, the method may comprise recirculating a portion of the gases from which coarser suspended particles have been separated through the sintering machine and subjecting the other portion of the gases to the vortical action.

26244

Zabel, Herman W.

NEW PENNSALT HF PLANT. Chem. Ind., vol. 66:508-509, 1950.

Use of reduced pressure in process equipment and thorough scrubbing with water has resulted in the successful control of fumes at a plant where hydrogen fluoride is formed in rotary kilns by the reaction of fluorspar with sulfuric acid. As a first step in HF purification, gas from the kilns is passed to coke-packed towers. These catch spar dust, entrained sulfuric acid, and some moisture condensates. The gas then goes to a surface cooler, after which it is liquefied in a two-stage steel condensor, the first water cooled and the second brine cooled. The gas from this condensor is scrubbed with water to absorb the last traces of hydrofluroic and hydrofluosilic acids. Before the exit gas is vented to the atmosphere, additional scrubbbing takes place in a water injector, which also serves to maintain a small negative pressure on the system. Thus all leakage is inward and no HF or hydrofluosilic fumes can escape to the atmosphere.

26279

Kozlov, V. A. and N. A. Tyurin

GAS SCRUBBING IN THE HYDRODYNAMIC DUST SEPARATOR DURING ELECTROLYSIS OF ALUMINUM. Soviet J. Non Ferrous Metals (English translation from Russian of: Tsvetn. Metal.), 9(12):68-70, Dec. 1968. 3 refs.

Design and operating data are given for a pilot hydrodynamic dust separator for treating fluorine compounds, dust, and resinous matter produced during aluminum electrolysis. The dust separator is a vertical chamber 3.1 m high and provided with two symmetrically located air scrubbing channels. The hydraulic resistance of the separator is 115 mm H2O with an optimum flow velocity of 19 m/sec. Gaseous fluorine is collected with 98% efficiency, dust with 73.2-77.7% efficiency, and resinous matter with 35-73% efficiency.

26317

Gelperin, N. I., V. M. Tarasov, and A. Yu. Valdberg

REMOVAL OF HYDROGEN FLUORIDE FROM GASEOUS MIXTURES WITH THE AID OF FLUIDIZED BED SCRUBBERS WITH SPHERICAL PACKING. (Ochistka gazov ot ftoristogo vodoroda v scrubberakh s psevdoozhizhennoy sharovoy nasadkoy). Text in Russian. Khim. Prom. (Moscow), no. 10:62-64, 1970. 4 refs.

A fluidized-bed scrubber designed to remove hydrogen fluoride from exhaust gases generated during electrolytic production of aluminum is described. A 40-50 g/l sodium carbonate solution was used at an irrigation density of 2.2-31 cu m/sq m/hr, a linear gas flow rate of 2.2-5.6 m/sec, and an initial HF concentrations of 15-150 mg/cu m. The static column packing height was variable from 35 to 175 mm. Operating characteristics in terms of the unit transfer number, defined as the logarithm of the ratio of HF concentrations before and after scrubbing, are presented.

26401

Stris, John

CONTROL OF FLUORINE AND HF DISCHARGES. A.P.C.A. News, 5(3): 3, April 1957. (Presented at the Semi-Annual Technical Meeting of APCA, Houston, Tex., Dec. 3-5, 1956.)

A method to control atmospheric fluoride emissions, successfully used at a plant which manufactures hydrofluoric acid from fluorspar, is described. The emissions are liberated from equipment used to purify the final hydrofluoric acid product. Polyethylene spray tower chambers were built which permit cocurrent and countercurrent flow of gas to water spray; the bottom of each chamber is open but submerged in water to form a seal. The water also allows waste discharge in a liquid state and permits redissolving of the silica gel that forms in the tower which would fall by gravity into the liquid. The technique involves almost no maintenance, and analytical samples of vent gases indicate no fluorine lost to the atmosphere.

26674

Rushton William E. and George Kleinman

METHOD AND APPARATUS FOR THE RECOVERY OF FLUORINE. (Whiting Corp., Ill.) U. S. Pat. 3,415,039. 6p., Dec. 10, 1968. 6 refs. (Appl. Nov. 3, 1965, 13 claims).

A method is described by which fluorine compounds evolved in equilibrium concentrations from an evaporator can be recovered by scrubbing the vapor product in a tower operated at a reduced pressure with respect to the pressure in the evaporator. In the manufacture of phosphoric acid by the wet process phosphoric acid technique, fluorine is evolved in varying amounts in the various stages of the process. In an evaporator for concentrating a dilute phosphoric acid feed wherein the evaporator is operated at an absolute pressure of about 8 1/2 inches Hg, the scrubbing tower could be operated at an absolute pressure of 2 inches Hg. These increased recovery efficiencies become particularly significant in those situations wherein the scrubbing solution has a fluosilicic acid concentration of 20% or more. Suitable pressure reducing devices include, for example, throttle valves and entrainment separators having high flow restriction properties. (Author abstract modified)

26745

First, M. W. and R. P. Warren

FIELD EVALUATION OF WET FIBER FILTERS FOR TREATMENT OF AIR CONTAMINANTS. J. Air Pollution Control Assoc., 6(1):32-34, May 1956. 5 refs. (Presented at the Air Pollution Control Association, 48th Annual Meeting, Detroit, Mich., May 23-26, 1955.)

Laboratory studies of the absorption efficiency of wet fiber cells and fiber droplet eliminators show recoveries of approximately 99.9% for hydrogen fluoride and greater than 90% recovery of submicron size chemical fumes and mists. Fibers are superior to the more usual types of packings in relation to the amount of surface available for absorption per unit volume, while high porosity of the fiber beds favors low-resistance gas flow. The porosity and relative efficiency of several packing materials are presented tabularly. Plastic fibers have excellent resistance to erosion and breakage; because of their specific gravity; they provide a large surface area per pound of packing. A minimum number of stages are required when the scrubbing liquid rapidly neutralizes or reacts with the gas or vapor to be removed from the gas stream. A wetted impingement type collector called a Neva-clog screen is capable of removing up to 85% of mineral particles (such as silica or talc dusts), and has considerable value as a gas absorption stage. An illustration is provided of a typical arrangement of wet and dry elements. Satisfactory air and gas flow rates are mentioned, as well as collector resistance. Results of field tests and a description of industrial gas scrubbers which were installed to control the discharge to the atmosphere of hydrogen fluoride, hydrochloric acid, and acetic acid-acetic anhydride are summarized. Operating conditions, manufacturing processes, design criteria, and an analysis of test results are also discussed.

26908

Benger, Michael

REDUCTION OF AIR POLLUTION ARISING FROM REFINERIES. In: Pollution Prevention. Inst. of Petroleum, London (England), Proc. Inst. Petroleum, Summer Meeting, Brighton (England), 1968, p. 28-38.

When a new refinery project is under consideration, consultations are held to ensure that the anti-pollution proposals are acceptable. Statuatory limits which are laid down by act of Parliament are well-established ones in which the technical possibilities by way of controlling emissions are well known. With the great majority of emissions, presumptive standards are laid down at the discretion of the Chief Alkali Inspector, and these can be altered as circumstances change. Technical feasibility, the effect on human and animal health, damage to vegetation, and odor thresholds are all taken into account. Potential nuisances include sulfur dioxide, hydrogen sulfide and mercaptans, fluorine, smoke, fuel ash, acid smuts, and noise. A major breakthrough in petroleum processing has been the replacement of the old liquid refining processes by catalytic desulfurization. Various methods used to control these pollutants are discussed, including cost factors. The Reinluft process is mentioned, as well as the Monsanto/Penelec process. The former utilizes activated carbon while the latter employs vanadium pentoxide. A dry absorption process utilized by the U. S. Bureau of Mines employs alkalized alumina to control SO2. The offensive odor of mercaptans may be controlled by stripping the condensate with steam or flue gas or both. Recently it has become common practice to use the sour condensates as wash water to crude oil desalters.

26911

Perrine, Richard L.

INTRODUCTION AND SUMMARY. In: Project Clean Air. California Univ., Berkeley, Task Force 5, Vol. 1, Section 1, 9p., Sept. 1, 1970.

Agriculture and forestry both are affected by and contribute to air pollution. Project Clean Air will establish a centrally located information center to collect and disseminate technical information on air pollution and provide educational materials and services. Use of power has grown at an alarming rate, and Project Clean Air will participate in the development of both selection criteria and basic data needed to facilitate energy management in California. More accurate methods will be developed by which to assess the economic losses to agriculture and forestry resulting from air pollution. A comprehensive program of research will be developed to determine: the growth depression effects on plants due to long-term low-level exposure to ethylene, sulfur dioxide, fluoride, and oxides of nitrogen; the extent of synergistic effects of combined sublethal concentrations of air pollutants on plants; the effects of air pollutants on the biochemistry, metabolism, and anatomy of plants; and the quality of the forest air environment where new damage is suspected. Ways and means to alleviate or modify agricultural, forest, and wood processing residue burning so as to minimize its contribution to air pollution are also indicated. A major program of research will be developed to make the expected transition to primarily nuclear power generation a safe one. Research will be developed to reduce nitrogen oxide emissions by means of combustion control, and several parallel projects will be developed to determine the potential usefulness of post-combustion removal of nitrogen oxides. Other recommendations include a program relating animal health to pollutants transported by air, ways to reduce dust resulting from livestock and poultry operations, and means to eliminate objectionable odors. The hazard from pesticide drift needs to be reduced, as well as sulfur dioxide emissions; industrial hydrocarbon and carbon monoxide emissions also need to be controlled. Project Clean Air will support research in which process engineering, meteorology, and economics are brought together to develop methods and criteria to optimally site the industrial emission sources which are currently most costly and hazardous.

27282

Ellison, William

WET SCRUBBERS POPULAR FOR AIR CLEANING. Power, 115(2):62-63, Feb. 1971.

While collection of gas-borne particles is the primary function of wet scrubbers, they also embody a number of additional process steps such as gas conditioning, liquid separation, and mist elimination. The principal mechanism involved in wet collection of particulate matter is impingement of individual particles upon scrubbing liquid droplets. Advantages of wet scrubbers include the following: compact equipment, a generally smaller capital expenditure than for fabric filters or electrostatic precipitators, ability to collect particles from 0.2 to over 10 micron, selection of collection efficiency by varying input, elimination of dust disposal, no limitation on temperature or humidity, and low maintenance costs. Requirements for minimizing emissions of sulfur dioxide, hydrogen chloride, and fluoride are mentioned. Operating costs, capital cost, dust collection efficiency, and gas pressure drop are compared for various types of wet scrubbers.

27569

Tomson, N. M.

GASEOUS EMISSION OF SUPERPHOSPHATE PRODUCTION AND RECOVERY EFFICIENCY. (Gazoobraznyye vybrosy superfosfatnogo proizvodstva i effectivnost' ikh ulavlivaniya). Text in Russian. Eesti NSV Tead. Akad. Toim, 4(1):134-136, 1955.

Installation of an electrofilter, and an increase in stack height from 60 to 100 meters reduced sulfur dioxide concentration in the vicinity of a superphosphate plant as follows: 49.5-fold at 500 meters distance, 37.8-fold at 1000 meters, and 9.7-fold at 2000 meters (actual concentrations at these distances: 0.42, 0.14, and 0.45 mg/cu m, respectively, with an emission concentration of 5000 mg/cu m). Nitrogen oxides emitted at a concentration of 5500 mg/cu m were reduced to 0.860, 0.042, and 0.100 mg/cu m at these same distances; hydrogen fluoride emitted at 900 mg/cu m, 0.23, 0.30, and 0.18 mg/cu m, respectively.

27835

Russell, W. E.

THE RECOVERY OF FLUORIDE FROM SUPERPHOSPHATE MANUFACTURE. Chem. Ind. New Zealand, 4(11):10-11, 13, Nov. 1968. 11 refs.

In the manufacture of superphosphate, finely ground phosphate rock is mixed with sulfuric acid in a continuous manufacturing process. Much heat is generated and gases are evolved containing mainly silicon tetrafluoride, carbon dioxide, and steam. A small water scrubbing system is described that permits a substantial part of the evolved fluoride to be recovered as 15% strength hydrofluosilic acid. This by-product is used for the fluoridation of public water supplies.

28034

UNIQUE GAS CLEANING JOB TRAPS FLUORIDES AT TSP PLANT. Air Eng., 4(3):46-48, 59, March 1962.

At the same time that design of a 600-ton per day triple superphosphate fertilizer plant was begun in 1956, an extensive program of air and stream sampling was initiated by the chemical firm. The program continued for five years, both to establish area pollution levels before plant operation, and to evaluate effectiveness of abatement procedures during operation. Once the monitoring program was set up, an on-the-spot tour of the sampling stations was arranged. In addition to comprehensive news releases and photographs, company personnel openly discussed the problems and the steps taken to solve them. Control measures include scrubbing, filtering, and various reactions to recover by-products. After three years of research, a solution to the problem of gaseous fluoride emission from the curing building was found. Instead of taking the pre-cured material from the settling belt and conveying it directly to the curing building, the product now drops from the settling belt into a chain mill, which breaks up the particles to a size of 1/2-in. or less. Control techniques at the chain mill and curing building are indicated, as well as the installation of electrostatic precipitators in the vicinity of the rock dust dryers. Precipitator operation is described.

28320

FILTER PROGRAM. (Filterprogramm). Text in German. Wasser Luft Betrieb, 15(1):36-39, Jan. 1971.

Various types of filters for cleaning waste gases are described. Gases escaping from electrolytic cells used in the melting of aluminum are cleaned by passing them through an aluminum oxide layer where the gaseous fluorides are absorbed. Next the gases are passed through envelope-type cloth filters which retain the aluminum oxide particles. The aluminum oxide is returned to the reduction cells, the fluorides to the melting zone. The process is a dry one which has the advantage of not converting an air-pollution problem to a water pollution

problem. A new wet dust collector consists of a high-capacity precipitator, 1200 mm high and 3000 mm long packed with synthetic material. Collection efficiency is about 99.4%. Water consumption is to 0.1 to 0.2 liters/cu m waste air. A filter for radioactive, pathogenic, and toxic substances consists of a rim board with O- grooves and a plastic sack that allows contamination-free replacement of the air filter. In a metallurgical plant, the dust-laden waste gases are conducted through water-cooled pipes to a scrubber, where the gases are washed with water. The scrubbing water circulates in a closed system to avoid water pollution.

28502

Prime Minister, Delegation for Scientific and Technical Research

SCIENTIFIC AND TECHNICAL MEANS OF DIMINISHING POLLUTION, INHALED OR ASSIMILATED FROM THE ENVIRONMENT--AND OF DIMINISHING ACOUSTICAL INTERFERENCE. (Moyens scientifiques et techniques de diminuer la pollution des milieux inhales ou ingeres et des 'nuisances' acoustiques). In: Pollution and Acoustical Interference of Industrial and Urban Origin. (Les pollution et 'nuisances' d'origine industrielle et urbaine). Vol. I, Paris, France, June 1966, Chapt. 3, p. 47-59. Translated from French. Belov and Associates, Denver, Colo., 49p., Oct. 13, 1970.

Aspects of natural and technological control methods for air, water, and noise pollution are discussed, with suggested topics of research given for each. Plants have an ability to function as air purifiers, within the limits of their toleration to various individual pollutants. The effects of such pollutants as ethylene, carbon monoxide, sulfur dioxide, and fluorides on plants are described. The purifying action of water plants and bacterial beds has application to water purification in treatment facilities as well as in natural fresh water bodies. Purification processes within the bed of a lake are also considered. Control methods for suspended particulates from industrial and domestic sources including separators, filters, and electrostatic precipitators, are briefly noted, while the various design, operational, and control device techniques now under study for control of motor vehicle emissions, particularly storage batteries for electric propulsion, design modifications and catalytic afterburners, are considered at length. Also discussed are pretreatment of industrially polluted waters, potential uses of water treatment sludge, and means for preventing and/or absorbing noise in residential, business, and industrial areas.

28709

Husmann, Klauss and Gernot Haenig

THE GRILLO-AGS-METHOD FOR DESULFURIZATION OF WASTE GASES. (Das Grillo-AGS-Verfahren zur Entschwefelung von Abgasen). Text in German. (Brennstoff-Waerme-Kraft, 23(3):85-91, March 1971.

The Grillo-AGS-method for desulfurizing waste gases is based on wet absorption of sulfur dioxide on an absorbent composed of magnesium and manganese oxides. This level combination of an alkaline component and a heavy metal has the advantage that the alkaline fraction acts as the absorbent and the heavy metals as the oxygen donator. A high activity is obtained by this interaction. More than 90% of the SO2 and the SO3 of the waste gases are bound by the absorbent in the form of sulfate and sulfite The efficiency of this method was tested on an oil-fired boiler furnace. For intense contact between the flue gas and the absorbent, a ratio of 0.7 l/cu m suspension flue gas was needed. The contact time ranged from 0.46 to 1.4 sec. A desulfurization efficiency of 85 and 90%, sometimes 95%, was obtained. Experiments to determine the efficiency of the method fo selective removal of SO3 and fluorine yielded 100% removal of SO3 and removal of fluorine 70%. The Grillo-AGS-method is one of the most economical desulfurization methods available. It creates no secondary problems, such as wastewater treatment or disposal of the absorbent.

28783

Hayashi, Hideo, Masahiro Yoshida, Masaaki Takahashi, Toshio Hasegawa, and Yoshiaki Yamasaki

REMOVAL OF FLUORIDES BY PACKED TOWER. (Juten to ni yoru fukkabutsu no jokyo). Text in Japanese. (Proceedings of the Japan Society of Air Pollution, Annual Meeting, 11th, 1970.)

The emission of fluorides from a hydrofluoric acid and aluminum fluoride manufacturing plant was investigated. The measurement was based on JIS-KO105-67, according to which gas is passed through three glass filter plates and through two serially arranged absorption bottles containing 0.1 N sodium hydroxide solution. For the emission from the reaction tank in the aluminum fluoride process, which generates a large amount of water vapor, the gas was separated from the mist before going to the filters by means of a trap. The samples were analyzed by alizarin complexion method. The gas emission from the absorption tower for hydrofluoric acid was 6.6-32.8 F mg/N cu m; that for gas leak was 115.6 - 215.4 F mg/N cu m. Since the absorption tower recycles the used water, the amount of fluorides tended to increase with the increase in the hydrofluoric acid concentration. For aluminum fluoride, when the synthesis began, the temperature inside the reaction tank rose and the amount of water vapor increased. The concentation of F in the mist was as high as 27.4 mg/N cu m; in the gas it was 17.9 mg/N cu m. The treatment efficiecy of the absorption tower was 78-99%.

28786

Hayashi, Hideo, H. Yoshikawa, Tamotsu Teratani, Toshio Hasegawa, Yasumasa Yamada, and Ko Narita

DUSTS TREATMENT IN NONFERROUS METAL MELTING FURNACES. (Hitetsu kinzoku yokoro no baijin shori). Text in Japanese. Taiki Osen Kenkyu (J. Japan Soc. Air Pollution), 5(1):185, 1970. (Proceedings of the Japan Society of Air Pollution, Annual Meeting, 11th, 1970.)

So that control measures could be established for metallic fumes, such as copper, zinc, and aluminum, several small nonferrous production plants were investigated. Emissions from a fused-zinc plating factory included ammonium chloride in addition to zinc chloride and zinc oxide. The particulates were very minute, and relatively little zinc was removed although scrubbers and absorption towers were provided. In an aluminum recycling plant, the treatment method was spray scrubbing. The waste gas whose temperature was quite high, consisted fo fumes of salts containing fluorine and chlorine. About two percent of the dust was aluminum; one percent was removed by treatment. Chlorine removal efficiency was about 46% and fluorine was not traceable. In a copper-wire manufacturing plant, the white smoke produced at the time the raw material is fed to the electric furnace and when the bath is taken out was collected by a hood and treated by bag filters. Dust collection efficiency was bout 99%. The amount of copper in the dust was 1 mg/N cu m while that of zinc was 200-300 mg/N cu m.

28889

Allmendinger, D. F., V. L. Miller, and Folke Johnson

THE CONTROL OF FLUORINE SCORCH OF GLADIOLUS WITH FOLIAR DUSTS AND SPRAYS. Proc. Am. Soc. Hort. Sci., vol. 56:427-432, 1950. 6 refs.

Data are presented from experiments conducted to control the scorch of galdiolus with foliar dusts and sprays. In 1948 the treatments consisted of a weekly spray of lime, dusts of lime at one-, two-, and three-week intervals, lime dust at one-week intervals with re-application after rains, and an untreated check. In addition to an unsprayed control, the 1949 treatments included the following materials applied at two-week intervals: lime spray, sugar-lime spray, magnesium silicate spray and dust, calcium silicate spray and dust, and dusts of lime, talc, and soil. Lime and sugar-lime sprays were applied at four-week intervals. Of the materials used, lime was the most effective in controlling scorch. Sprays were more effective in controlling the scorch than were dusts. Chemical analyses showed that the lime absorbed considerable quantities of fluorine, and the amount of fluorine in the plant tissue was markedly less as the effectiveness of the sprays and dusts in controlling scorch increased. (Author summary modified)

28945

Donaldson, Harry M.

PROBLEMS IN THE CONTROL OF OPERATIONS IN A BERYLLIUM-PROCESSING PLANT. A.M.A. Arch. Ind. Health, 19(2):221-224, Feb. 1959.

Problems of control of a beryllium processing plant are extensive and begin with the conception of the idea that the plant must be built. First of all, the plant must be located on a stream capable of carrying away any liquid wastes generated in the process and, like any chemical plant, it should preferably be built in a locatio where accidental contamination of the environment will not be a health hazard or cause property damage. Though many processes and many types of process equipment are available for the recovery of beryllium, the problem in choosing that process and that equipment which are capable of being controlled down to 2 micrograms per cubi meter is a major one. The next problem of importance after choosin the process and equipment that can be ventilated is to apply the principles of local exhaust ventilation to the equipment in such a way that contamination in the plant is limited to the stringent requirement of 2 micrograms Be/cu m. An extensive air cleaning system is necessary to keep outplant air at less than 0.01 microgra Be/cu m. All employees working in the plant are supplied with a complete change of clothing and are required to take a shower in order to keep beryllium from going home with the worker. Sometimes there are dermal problems which result from working with beryllium fluoride or ammonium beryllium fluoride. Other problems include the indoctrination of new employees as well as working with veteran employees. Both in-plant and out-plant sampling programs are never ending.

29114

Teller, Aaron J.

NEW CONCEPTS OF POLLUTION CONTROL. Trans. N. Y. Acad. Sci., 32(7):837-842, Nov. 1970.

Pollution control has been looked on as a 'nonprofit necessity' rather than as a source of material for recycle or sale. Because of this, engineers have incorrectly applied the technology of product separation to highly concentrated streams. What is needed for engineering solutions to air pollution problems is acceptance of the fact that boundary conditions are distinctly different from product-oriented separations. These conditions are discussed and four successful approaches to abatement based on their consideration are presented. A cross-flow scrubber permits 99.7% recovery of hydrogen fluoride and silicon tetrafluoride. A Brownian separator is capable of removing submicron liquid particles at pressure drops of 5-30 in. wg, while a nucleation scrubber collects both liquid and solid submicron particulates at a pressure drop of 2 in. wg. A new cooling tower provides cooling of 25,000,000 BTU/hr in a ground space of 120 sq ft. The surface-renewal capability of the packing internals constantly creates new surface for rapid mass heat transfer. A 'looped system' recycles hydrogen fluoride and submicron boron oxides back to the process, while dissipating the thermal energy in the exhaust in a cooling tower.

29403

Strauss, W.

THE REMOVAL OF A GASEOUS CONSTITUENT: ABSORPTION, ADSORPTION AND COMBUSTION. FLUID RESISTANCE TO PARTICLE MOTION. GRAVITY AND MOMENTUM SEPARATION EQUIPMENT. In: Industrial Gas Cleaning. The Principles and Practice of the Control of Gaseous and Particulate Emissions. New York, Pergamon Press, 1966, Chapt. 3, p. 62-121; Chapt. 4, p. 122-143; and Chapt. 5, p. 144-159. (For references, see 29405.)

The three methods of removing gaseous constituents from flue gases are absorption in a liquid, adsorption on a solid surface, or a chemical change into a harmless gas, usually by combustion. The molecular diffusivity is calculated, and a film theory of absorption and the design of absorption systems in presented. Gas absorption processes are described for sulfur dioxide, fluorine and fluorine compounds, chlorine and chlorides, hydrogen sulfide, and nitrogen compounds. The adsorption of gases on solids and the combustion process of flame combustion and catalytic combustion are explained. The calculation of the fluid resistance to the cross-stream movement of the particle is essential in determining the effectiveness of a particular mechanism in removing the particle from the gas stream. The calculation of the resistance of a fluid to the movement of particles when these are acted on by forces outside the fluid are discussed. The simplest method for removing particles from a moving gas stream is to allow them to settle out under the force of gravity. Momentum separators rely essentially on producing a sudden change of direction in the gas stream. The theory of settling chamber design and applications of simple settling chambers are described. Momentum separators are more complex but take up less room and are able to collect particle down to about 20 microns with reasonable efficiency.

29680

Bender, Rene J.

AIR POLLUTION CONTROL: WHERE DO WE STAND? WHERE MUST WE GO? ... AND HOW DO WE GET THERE? Power, 115(6):S.4-S.11, June 1971.

While adequate monitoring equipment is available, research is underway to improve the instruments. Fuel oil burning produces carbon monoxide; by monitoring the oxygen with a Polarographic method, combustion can be held at an ideal fuel-oil firing condition. The atomic absorption spectrophotometer and thin-layer chromatography followed by a fluorescence analysis are other measurement methods. Some improvement in air quality has occurred. The Federal Clean Air Act of 1970 has established air quality standards for sulfur dioxide, particulates, nitrogen oxides, CO, hydrocarbons, and

oxidants. A compact monitoring system for SO2, NOx, hydrogen sulfide, fluorides, aldehydes, and oxidants uses absorption columns and colorimetry. An electrochemical transducer can monitor nitrogen oxides and SO2. Particulate mass can be measured with a beta-ray beam passing through a filter. Firing conditions can effect stack gas composition. Also, gas-cleaning equipment can include water sprays, mechanical dust collectors, separators, dry scrubbers, fabric filters, electrostatic precipitators, cyclone dust collectors, bag filters, venturi scrubbers, impingement trays, wet scrubbers, or afterburners. Sulfur dioxide can be eliminated by the use of low sulfur fuels or the treatment of flue gases. Many pilot plants are attempting to recover the sulfur product. The most promising and economical SO2 removal method depends on the scrubbing of gases with soda ash followed by the conversion of the product to calcium sulfite under the action of lime. The Tennessee Valley Authority is trying out several SO2 removal processes. Nitrogen oxides are found in automotive exhaust and flue gas; they can be reduced by control of the combustion process. Fuel additives may also help stop atmospheric pollution. Tall chimneys are not the final answer to air pollution, but are an excellent stopgap. Pollution controls in incinerators, and the metallurgical industry (ferrous, bronze, and brass) are also discussed. The amount of emissions for multiple and single chamber incinerators, blast furnaces, sintering machines open hearths, electric arc furnaces, basic oxygen furnaces, crucibles, reverberatory furnaces, and rotary furnaces are given before and after the use of control equipment.

29725

Ussar, Max

TECHNOLOGY RENDERS ITS SERVICES TO AIR PURIFICATION AND NOISE SUPPRESSION AS PART OF ENVIRONMENTAL HYGIENE. (Die Technik im Dienste der Luftreinhaltung und Laermminderung als Teil der Umwelthygiene). Text in German. Gas Wasser Waerme, 25(4):62-65, April 1971.

In order to successfully combat air pollution caused by dust and gases, it is necessary to know the chemical and physical properties of these substances, and the concentrations in which they occur in the free atmosphere and at the source from which they originate. Devices for air sampling as well as for analysis of the dust and gases have been developed, but more standardization of methods would be desirable on a national and international basis. In air pollution by dust particles and gases, one differentiates between emission from sources, such as industrial plant, and emission which is the actual content of pollutants in the surrounding air, derived from all origins, such as dust from emissions and dust which is whirled up from the soil by moving air. Principal methods and equipment respectively for large scale dust removal are sedimentation, filtering, cyclones, high capacity washers of venturi type, and electrostatic separators. With regard to gases, the main industrial problem is the removal of troublesome and toxic gases such as sulfur dioxide, chlorine, fluorine, and nitric oxides which can be damaging to forestry and agriculture, and a health hazard to the human organism. One of the most applied methods in industries which generate waste gases containing any of the aforementioned gaseous pollutants is washing. In more recent years noise has become a very damaging occurrence in our environment. Future planning of residential buildings and industrial installations will have to take into account the need for acoustic insulation and noise suppression.

30276

Lux, Herbert and Hardi Stange

RESULTS OF FIVE-YEAR EFFORTS FOR REDUCTION OF FLUORINE EMISSIONS. (Ueber Ergebnisse fuenfjaehriger Bemuehungen un die Verminderung von Fluoremissionen). Text in German. Chem. Tech. (Berlin), 23(4/5):264-266, April/May 1971. 2 refs.

When various methods were investigated for the removal of hydrogen fluoride from waste gases, such as packed columns and absorption on activated charcoal or limestone, it was found that absorption was not efficient. The use of packed towers requires that the flow rate not exceed one m/sec. Each packed tower must be operated with an alkaline solution; a five to 10% sodium or potassium lye solution can be employed. While packed columns are easy to maintain, some production processes have waste gases which carry dust that may form insoluble products with the scrubbing fluid. Dust collectors should precede the packed tower in such cases. It is also advantageous to force the gases through the tower, to avoid some of the problems which its moveable parts may present.

30519

Ball, D. F. and P. R. Dawson

AIR POLLUTION FROM ALUMINIUM SMELTERS. Chem Process Eng., 52(6): 49-54, June 1971. 16 refs.

Control methods for a number of the pollutants emitted during aluminum production are discussed. The production process is briefly described. The main pollutants which arise in electrolysis are alumina, tar-pitch distillation products, inorganic fluorine, compounds including hydrogen fluoride, sulfur dioxide, hydrogen sulfide, carbonyl sulfide, carbon disulfide, silicon tetrafluoride, and water vapor. The gases from the furnace contain fluorine compounds, carbon monoxide, carbon dust and tar, and hydrocarbons. These gases are sent to an afterburner, a cyclone, and an electrostatic precipitator. The gases may still contain HF and SO2, which can be removed by scrubbing with an alkaline solution. Ventilation is important in the potrooms to keep temperatures low and to remove fluorine compounds and dust from the room air. The large volumes of air withdrawn through the roof are usually cleaned with sprays or wet scrubbers. One new development is to clean the gases by absorption of fluoride on alumina followed by the removal of solid from the gas stream using bag filters. The costs and operating charges associated with the gas cleaning will vary with the design and location of the installation. The effects of fluorides on man and air quality standards are briefly discussed.

30814

Kitano, T., Z. Kawase, S. Ito, and S. Yuge

AIR POLLUTION AROUND THE ROOF-TILE-KILN. (Yuga kojo shuhen no taiki osen chosa). Text in Japanese. Taiki Osen Kenkyu (J. Japan Soc. Air Pollution), 5(1):162, 1970. (Proceedings of the Japan Society of Air Pollution, Annual Meeting, 11th, Tokyo, Japan, 1970.)

Many roof-tile kilns in northern Saitama Prefecture changed into manufacturing glazed tiles in recent years and caused considerable fluoride damage in the mulberry fields in the area for the last three years. Approximately a 400 m radius of these factories, especially the leeward areas, were completely unsuitable for sericulture; damage to rice, corn, and cucumber was also noted. The Saitama Prefectural Institute of Public Health ordered an installation of detoxification devices to the twelve glazed tile factories in 1970. The device is designed to

clean fluoride and other fumes from the tunnel kiln by a 10% solution of sodium hydroxide and to turn the waste liquid into calcium fluoride and sodium sulfite. A cooling tower prevents the rise of the absorbent and white smoke. The fluoride content in the air permitted by the Saitama prefecture law is 3 ppm. As a result of the detoxification device, sulfur oxides in the smoke decreased from 29.1 to less than 1.0 ppm; hydrogen fluoride, from 6.4 to 1.2 ppm; and dusts, from 18.8 to 1.5 mg/cu m. The fluoride content in mulberry leaves decreased from 6.4 to 2.0 mg/100 g in 80 m west of the factory; from 1.5 to 1.4 in 140 m east of the factory; and from 3.1 to 1.6 in 200 m north of the factory.

31567

Cook, C. C., G. R. Swany, and J. W. Colpitts

OPERATING EXPERIENCE WITH THE ALCOA 398 PROCESS FOR FLUORIDE RECOVERY. Air Pollution Control Assoc. J., 21(8):479-483, Aug. 1971. 1 ref.

Following the application of water scrubbers, cyclones, and electrostatic precipitators, Alcoa Research Laboratories at New Kensington, Pennsylvania, discovered that small quantities of hydrogen fluoride would react at low temperature with alumina. The Alcoa 398 Process was developed, incorporating a fluidized bed reactor to contact pot gases with incoming feed alumina. Bag filters are used to separate entrained solid materials from pot gases. Ninety-five percent interception of pot gases is reported with 99% recovery of fluorides from gases treated. Installation costs are in the range of $18-37 per annual ton for new installations and about 50% more for conversion of old plants. Direct operating costs range from $2.90 to $4.70/ton of aluminum and recover eight dollars worth of fluorine, giving a net credit. A general description of the Alcoa 398 Process is included, and applicability and limitations are discussed. Performance efficiency, effect on metal purity, and maintenance are mentioned.

31708

Hartig, Rufus G.

PROCESS FOR RECOVERY OF HF AND H2SIF6 FROM GASES CONTAINING HF AND SIF4. (Assignee not given.) U. S. Pat. 3,574,542. 5p., April 13, 1971. 9 refs. (Appl. March 5, 1969, 2 claims).

Waste gases from phosphoric acid plants usually contain silicon fluoride. When absorbed in water, the SiF4 reacts with hydrogen fluoride to form H2SiF6, which in turn reacts with sodium fluoride to form Na2SiFe6. This material contaminates the NaF and also the ultimately produced HF with SiF4. The invention provides for the removal of SiF4 prior to HF recovery, and thus for recovery of HF of high purity. Gases leaving an electrostatic precipitator are contacted with an aqueous suspension of NaF and NaHF2 or KF and KHF2, the suspensions being maintained in excess to suppress absorption of HF. The contact with the aqueous suspension causes the SiF4 to precipitate from the gas as a fluosilicate salt, which is heated and decomposed to evolve SiF4. The evolved SIF4 is then absorbed in water to form an aqueous solution of H2SiF6 from which silicon dioxide is separated. Hydrogen fluoride is then separately recovered from the SiF4-free gas obtained early by contacting the waste gases with the aqueous suspension.

31889

Yamaguchi, Fumihiko

DESULFURIZATION OF STACK GAS BY TCA METHOD. (TCA ho ni yoru haien datsuryu). Text in Japanese. Netsu Kanri (Heat Management: Energy and Pollution Control), 23(7):12-20, July 1971.

Turbulent Contact Absorber (TCA) equipment has been popular for its performance, easy handling, and no need for maintenance. The equipment comprises two grids in the lower and upper part of a tower and, in between the grids, a small quantity of light, plastic balls which are filled and act as a catalyst between the gas and liquid. By allowing the gas and liquid to flow at high speed, the balls are given a turbulent motion, so that the gas and liquid are brought into intimate contact. There is no clogging of the equipment due to dust, while a considerable volume of gas can be handled with stable operation even if there is a change in gas volume. TCA equipment has been used for processing sulfur dioxide, chlorine, hydrogen fluoride, hydrogen sulfide, and other sulfur-containing gases. Alkaline calcium salt compounds may be used as the absorbent.

32190

Faith, W. L.

GASES. In: Air Pollution Control. New York, John Wiley, 1959, Chapt. 5, p. 142-178. 84 refs.

Gaseous contaminants in the atmosphere arise from two general sources: combustion of fuels and the handling and processing of chemicals. The latter category includes not only chemical manufacture but related activities, such as petroleum refining, smelting of ores, and various solvent-handling activities. Almost every gaseous material known escapes to the air at one time or another, but the most common by far are sulfur dioxide, carbon monoxide, hydrogen sulfide, hydrogen fluoride, chlorine and its compounds, nitrogen oxides, and hydrocarbons. These gases are reviewed with respect to their specific sources, analysis, and abatement.

32231

AIR POLLUTION CONTROL, NATIONAL FERTILIZER DEVELOPMENT CENTER, WILSON DAM, ALABAMA. Tenn. Ind. Hyg. News., 22(1):1-5, Winter 1965.

In the fertilizer development center, dusts are evolved from the agitation of solid dry materials. The phosphatic dusts are relatively easy to collect, being noncorrosive and fairly heavy. Coke and coal dusts are non-corrosive but less dense. Simple dry cyclones with collecting efficiencies of 80-90% are useful as precleaners. These must be followed by a wet scrubber. At the nodulizing kilns, an electrostatic precipitator is employed for dust removal, and a scrubber is used for fluorine removal. Resolution of industrial hygiene-air pollution problems is based primarily on exhaust ventilation, modernization of air-cleaning equipment, and confinement of process materials to the process. Pollution control activities between 1950 and 1968 are described. During 1960 to 1968, a new stainless steel phosphoric acid unit was added where fluorine and phosphoric anhydride losses are reduced to a negligible amount. A phosphorus centrifuge for treating phosphorus sludge was also added. Improved oxides of nitrogen removal was accomplished with small pressure nitric acid units. Wet, dynamic scrubbers were installed. A 165 ton/day high-efficiency nitric acid unit was also added. Ammonia, dusts, fluorine, nitrogen oxides, P205, and sulfur dioxide have been reduced since the initiation of the control system.

32232

Gartrell, F. E. and J. C. Barber

POLLUTION CONTROL INTERRELATIONSHIPS. Chem. Eng. Prog., 62(10):44-47, Oct. 1966. 3 refs.

Air pollution and water pollution control in industrial applications are closely related. Waste products are discharged for dilution and transport from their source into the atmosphere or a watercourse. They are discharged to open waste lagoons, storage areas, or, as in the case of high level, long-lived radioactive fission products, to permanent storage in closed containers. Devices for air pollution control which reduce the amount of waste material discharged to the atmosphere usually increase the quantities of such materials that must be disposed of by other means. Waste gas control in an ammonia plant, fluorine control in a phosphate plant, and fly ash control in coal-fired power plants were discussed. A scrubbing system was developed for the removal of ammonia from the gases given off when the copper solution was regenerated. Ammonium carbonate, the liquid waste, replaced about 36% of the ammonia previously supplied as ammonium hydroxide. Fluorine is controlled by a jet-venturi fume scrubber. Accumulated fly ash is pulled from collector hoppers by an induced vacuum. The vacuum is produced by a vertical venturi ringed internally with downward directed water nozzles. The water and ash are discharged into an air-separator tank which removes air from the mixture. The ash sluice water then flows by gravity or is pumped to the ash ponds. The ash settles in the pond; the overflow is discharged to the nearest watercourse.

32384

Arkhipova, L. N., V. M. Ramm, and I. M. Maltseva

METHODS OF PURIFICATION AND FURTHER PROCESSING OF FLUORINE CONTAINING GASES IN THE PRODUCTION OF PHOSPHATE FERTILIZERS. (Metody ochistki i pererabotki ftorcoderzhashchikh gazov ot proizvodstv fosfornykh udobrenij). Text in Russian. Zh. Vses. Khim. Obshchestva im. D. I. Mendeleeva, vol. 14:415-420, 1969. 70 refs.

The choice of the gas purification method for fluorine-containing stack gases produced during phosphate fertilizer production depends on the character of the purified gases (the fluorine and dust content). In gases free of dust, silicon tetrafluoride can be recovered by absorption in water or ammonia solution. Dust containing gases have to be dedusted in cyclones and then SiF4 can be obtained by absorption in sulfuric acid. Gases of low fluorine content containing dust can be purified directly by wet methods. Some industrial designs of the above methods are discussed. Further processing of absorbed fluorine leads, according to the method used, to one of the following products: sodium fluorosilicate, sodium fluoride, aluminium fluoride, sodium aluminium fluoride, potassium fluoride, hydrogen fluoride. If both technologic and economic aspects of the problem are considered, only a limited number of the above methods is suitable for practical realization.

32461

Kangas, J., E. Nyholm, and J. Rastas

SMELTER GASES YIELD MERCURY. Chem. Eng., 78(20):55-57, Sept. 6, 1971.

A technique was developed which scrubs the sulfur dioxide-rich gases from smelter or roasting operations of mercury before the gas is processed for sulfuric acid production. At the Kokkola plant of Outokumpu Oy (Finland), zinc concentrates are roasted in a fluidized-bed furnace at at temperature of 950 C. Mercury sulfide contained in the concentrate decomposes completely and mercury vaporizes. The heat contained in the gases is recovered in a waste heat boiler, and dust is separated from the gas by means of cyclones and electrostatic precipitators. Mercury-containing gases coming from the electrostatic precipitators at a temperature of 350 C go to the sulfatizing unit. The mercury sulfatizer is a brick-lined tower containing ceramic packing, in which mercury-bearing gases contact a countercurrent flow of strong sulfuric acid. Mercury and selenium are scrubbed from the gas by the acid. Sulfuric acid flows from the bottom of the tower to an intermediate storage tank, it is then pumped through a heat exchanger and recycled to the tower. Zinc and iron salts, as well as chlorides and fluorides, can also be removed in this process. Washing the precipitate, and the production of metallic mercury are mentioned.

32627

Dagan, B. N.

CLEANING OF OPEN HEARTH WASTE GASES BY KAISER STEEL CORPORATION, CALIFORNIA. Proc. Nat. Open Hearth Basic Oxygen Steel Conf., vol. 37:72-78, 1954. 2 refs.

A precipitator installed on an open hearth furnace and dust and gas problems inherent to the open hearth process are described. The precipitator was directly connected between the induced-draft fan outlet and the stack. The precipitator was energized by two 25-kva full-wave mechanical rectifiers with a stand-by rectifier and an integrated high-voltage switch gear, so that the spare rectifier could be used with either transformer. Automatically controlled impulse-type rappers were used for cleaning the collecting electrodes. The collected dust, averaging approximately 3000 lb/day, was intermittently removed from the hoppers. The precipitator consistently performed at an efficiency between 90 and 96% with a loss of approximately 0.03 grain/standard cu ft. The precipitator collected between 105 and 140 lb of open hearth dust/hr. About 90% of the partiuclate matter was under five micron in size. Chemical analysis and x-ray diffraction indicate that the dust was composed primarily of iron oxides and is wholly magnetic. The two major problem areas were sulfur trioxide and fluorine. Thermodynamic data are discussed.

32712

Calvez, Claude and Andre Pailhiez

COMPARED TECHNOLOGIES FOR THE COLLECTION OF GASES AND FUMES AND THE VENTILATION OF ALUMINUM POTLINES. Metallurgical Society of AIME, New York, Design Metal Prod. Processes Conf. Proc., Chicago, Ill., 1967, p. 158-171. (Dec. 11-13.)

Aluminum producers are increasingly concerned about problems raised by the collection of gas and solids and the ventilation of the lines of aluminum cells. Engineering solutions to these problems have been achieved at two plants employing Soderberg cells, one having a lengthwise arrangement of raised shells and the other a crosswise arrangement of cells with bedded shells and prebaked anodes. Since the cells alone were insufficient to prevent air pollution, the first plant now aspirates gases collected in the cells to the roof where they are first cleaned in electrofilters, then washed with sodic solution and water in two-stage spray scrubbers. Subsequent precipitation with sodium aluminate yields a substantial amount of fluor in the form of cryolite. Total cleaning efficiency for both roof and floor installations is close to 93%. At the other plant, there is one scrubber for every four cells, which insures almost continuous aspiration and washing. Washing is carried out with pure water. Gases are almost completely trapped, and washing efficiency reaches 90-92%.

32963

McClain, R. S., G. V. Sullivan, and W. A. Stickney

RECOVERING ALUMINUM AND FLUORINE COMPOUNDS FROM ALUMINUM PLANT RESIDUES. U. S. Bureau of Mines, Rept. 5777, 16p., 1961. 1 ref.

Residues from aluminum plants were investigated to determine if carbon could be removed by flotation while recovering fluorine and aluminum compounds for recycling to the reduction process. Samples of flue dust, pot skimmings, and pot linings all responded to a simple turpentine flotation scheme to reject 90-97% of the carbon. Aluminum compound recoveries were 42-94% on the flue dust, about 95% on the pot skimmings, and 75-89% on the pot linings. Fluorine recoveries from the same samples were 35-63, 92-95, and 77-86%, respectively. The pot linings contained soluble aluminum and fluorine salts that were recovered by precipitation with sodium aluminate and carbon dioxide gas. Composites of residues responsed to flotation much the same as the individual samples. (Author summary modified)

33191

Ruch, J. B.

VPP--DESIGN CRITERIA FOR AN INSTALLATION TO REMOVE HYDROGEN FLUORIDE AND FLUORINE FROM THE CELLS 1 AND 2 VENTILATION GASES PRIOR TO FILTRATION. Preprint, Oak Ridge National Lab., Tenn., 19p., April 11, 1960. 18 refs.

Criteria are presented for a horizontal spray nozzle scrubbing system designed to remove fluorine and hydrogen fluoride from the 3000 cfm of ventilation air passing through the Volatility Pilot Plant, built for uranium recovery studies of irradiated zirconium-uranium nuclear submarine fuels. A reduction of fluorine concentrations from 1520 to less than 2 ppm during a total release of 68 lbs, and a reduction of hydrogen fluoride concentrations from 4090 to less than 1 ppm during a total release of 200 lbs, will adequately protect the ventilation system fiberglas filters. Six scrubbing stages each containing four nozzle-throat spray units are needed with a 5-10% aqueous caustic potash recycle system pumping at a maximum rate of approximately 180 gal/min, with a range per nozzle from 3-7 gal/min. The scrubber will be 4 ft by 4 ft by approximately 25 ft, containing a deentrainment section of baffles and a demister. The associated ventilation system hardware, services, and instrumentation requirements are given. (Author abstract modified)

33554

McCann, C. R., J. J. Demeter, A. A. Orning, and D. Bienstock

NOX EMISSIONS AT LOW EXCESS-AIR LEVELS IN PULVERIZED-COAL COMBUSTION. Preprint, American Society of Mechanical Engineers, New York, Air Pollution Controls Div., 8p., 1970. 21 refs. (Presented at the American Society of Mechanical Engineers, Winter Annual Meeting, New York, Nov. 29-Dec. 3, 1970, Paper 70-WA/APC-3.)

Emissions of air pollutants are reported in the combustion of 500 lb/hr of pulverized coal at various excess air levels in a dry-bottom furnace with water-cooled walls. Nitrogen oxides decreased 70% (from 575 ppm to 175 ppm) as excess air was lowered from 25 to 1.4%. Retention of coal sulfur by the ash was 2.4%, the balance appearing as sulfur oxides in the furnace gas. Sulfur dioxide ranged from 1415 at 21.4% excess air to 1785 ppm at 3.8%. Sulfur trioxide values were one to seven ppm. Retention of coal chlorine by the ash was 4.6%, the balance appearing as 8.0 to 14 ppm hydrogen chloride in the combustion gas. Retention of coal fluorine by the ash was 11.2%, the balance emitted as 8.0 to 14 ppm hydrogen fluoride in the gas. At lower excess air levels, carbon combustion efficiencies could be maintained at 99% by increasing the air preheat from 600-650 F to 700 F and maintaining a stable air-fuel ratio. (Author conclusions modified)

33620

Teworte, W.

ENVIRONMENTAL PROTECTION FROM THE VIEWPOINT OF THE NON-FERROUS METAL INDUSTRY. (Umweltschutz aus der Sicht der NE-Metallindustrie). Text in German. Z. Erzbergbau Metallhuettenwesen, 24(10):505-506, Oct. 1971. (Presented at the Gemeinsamen analytikertagung, Duesseldorf, Germany, June 3, 1971.)

The non-ferrous metallurgical industry has solved the problem of sulfur dioxide emission: no sulfide-containing ore is processed without the subsequent production of sulfuric acid. In 1970, the equivalent of 550,000 tons of SO2 went into the sulfuric acid production process. Dust collectors are employed at pyrometallurgical processes. In one method, furnace gases are drawn off to be cleaned and, in another method, the entire air in the workshop is cleaned. Fluorine emissions still present problems, and more research is required here.

33918

Okumura, Eijiro and Hiroyasu Matsumoto

DESIGN OF FLOATING SCRUBBER AND TURBULENT ABSORBER. (Shishiki shujin oyobi gasu kyushu sochi no sekkei - Furotingu sukurubba, taburento abusoba ni tsuite). Text in Japanese. Kagaku Sochi (Plant and Process), 9(10):11-22, Oct. 1967. 4 refs.

The Floating Scrubber (FBWS), wet type dust collection device, and the Turbulent Absorber (TCA), a gas absorption device, were discussed including their basic mechanisms, construction, and design theories. Practical applications include dust removal in iron manufacturing plants; dust removal, sulfur dioxide recovery, and gas absorption in pulp factories; dust removal in steel manufacturing dust removal in sulfuric acid manufacturing plants; absorption of SO2 from waste gas in H2SO4 manufacturing plants; recovery of fluoride compounds from waste gas phosphoric acid manufacturing industry and from waste gas in aluminum manufacturing industry. Both the FBWS and TCA are scrubber columns filled with lightweight plastic balls between two grids. The washing liquid is sprayed through a nozzle from above and the gas to be treated is fed in from below; the gas causes a violent turbulent motion as it ascends to contact the wash liquid. Since the gas-liquid contact system occurs in the space between the two grids, the balls contact the media, float with the gas and liquid. Since the gas-liquid contact system occurs in the space between the two grids, the balls contact the media, float with the gas and liquid, revolve, and hit each other, thus causing stirring. This keeps the surface of the balls clean so that a new liquid film can form. Also, the area of contact between the gas and the liquid is enlarged for effective dust collection and gas absorption. The constant stirring keeps the grid meshes free from viscous or other substances formed by the absorption reaction. This is known as self-cleaning. Both FBWS and TAC are patented to UPO of the U.S.A. and feature no clogging, even with viscous substances; low pressure loss compared with its high gas velocity; higher contact effect resulting in higher efficiency; and stable and long-life performance.

33971

Mashita, Takashi

WET-TYPE DUST COLLECTOR UTILIZING CONDENSATION. (Gyoshuku o riyo shita shisshiki shujinki soriboru). Text in Japanese. Sangyo Kogai (Ind. Public Nuisance), 7(10):573-574, Oct. 1971.

A new, wet-type dust collector consists of a casing, and many venturi pipes arranged in parallel in the casing, and water jet nozzles at the both ends of the pipe bundle. Dust-containing

gas flows into the casing and into the narrow part of the venturi pipes where the speed and pressure drop. Vapor condensation occurs and dust particles are covered by a thin liquid film. The turbulent air current created at the narrow throat and the difference in sizes and weight of the particles cause collision of dust particles and water drops, enlargine each particle. As they leave the venturi pipes, they are sprayed by the water jet and large dust particles drop down as sludge. Clean gas goes through a vapor separation apparatus and is discharged. This apparatus is particularly effective for collection of large quantities of small particles (down to 0.04 micron). The contact of the gas and jet liquid is great and uniform, and toxic gases such as sulfur dioxide and fluoride can be absorbed easily. The decrease in flow speed or quantity has no effect on the collection efficiency. The circulation of the jet water is easy, and the maintenance of the spray nozzle is easy because of the large opening. Wearing from friction is limited because of the slow speed of the gas.

35106

Ministry of Commerce and Industry (Japan), Dept. of Environmental Pollution

AIR POLLUTION. (Taiki osen). Text in Japanese. In: A Survey of Industrial Pollutant Disposal Machines - 1971. p. 68-122, Dec. 1970.

A general discussion of control techniques methods of selecting a dust collector, calculation of collection rate, power requirement for a dust collector, and principles of various collectors such as settling chambers, inertial collectors, centrifugal separators, scrubbers, filters and electrostatic precipitators, are explained with illustrations. Methods of toxic gas treatment by absorption and adsorption are explained with illustrations. Representative toxic gases such as hydrogen sulfide, nitrogen oxides, hydrogen chloride, chlorine, fluorides, and ammonia are discussed. For sulfur dioxide, importation of low sulfur oils and desulfurization methods are discussed. Hydrogenation of heavy oil, wet absorption, and active carbon adsorption of stack gases are discussed with flow sheets. Cleansing of automobile exhaust gas, combustion improvement, smoke dispersion, and coal and oil additives are discussed. Various types of dust collectors and desulfurization systems available on the market are listed with illustrations and photographs.

35111

Givaudon, Jean

ACTION IN THE CHEMICAL INDUSTRY. (Action dans l industrie chimiques). Text in French. Pollut. Atmos. (Paris), vol. 13:44-47, Oct. 1971.

One of the plants of the Solvay Society installed dust arresters on top of furnaces and cyclones to control fine dust emanating from polyvinyl chloride manufacture, converted some boilers from coal to natural gas, eliminated all leaks of chlorine in its electrolytic installations, and disposed of several liquid chlorinated pollutants by combustion. In general the French chemical industry disposes of pollutants by absorption (recovery of fluorine in aluminum plants, control of effluents from sulfuric acid plants where residual gases containing 0.20 to 0.25% sulfur dioxide are purified by washing with a diluted ammonia solution down to 0.02%, absorption of maleic and citraconic anhydride from effluents of the phtalic anhydride manufacture) by combustion and catalytic oxidation (a special incinerator completely disposes of most undesirable liquid waste), or by other processes (pilot plant desulfurization of waste gases from coal-fired power plants catalytic afterburners for internal combustion engines).

35448

Berly, Edward M., Melvin W. First, and Leslie Silverman

REMOVAL OF SOLUBLE GASES AND PARTICULATES FROM AIR STREAMS WITH SPECIAL REFERENCE TO FLUORIDES. Atomic Energy Commission, Washington, D. C., Contract AT(30-1)-841, Rept. NYO-1585, 49p., April 18, 1952. 16 refs.

High efficiency absorption of soluble or reactive gases can be obtained with available equipment using wetted fiber beds. Wetted fibers are many times more efficient than Raschig rings or Berl Saddles when compared on the basis of equal volumes. When compared on the basis of weight of packing, one pound of 78-micron diameter Saran fibers are about 150 times more efficient for the absorption of hydrogen fluoride gas than one pound of 1/2-inch Raschig rings. This reduction in weight and bulk can be utilized to realize important savings in construction and maintenance of gas absorbing systems. A five-stage system of concurrently-wetted fiber beds and countercurrent stages can produce 75% hydrofluoric acid from 19.8% HF gas and give a gaseous effluent which is hygienically safe. High efficiency collection generally requires the addition of a droplet eliminator composed of a 1-inch to 2-inch depth of dry fibers less than 5 microns in diameter. For particulate collection, best results are obtained when particles and the surfaces on which they are to be deposited are of the same size. When treating gas streams containing inert particles, the absorbing stages can be protected from fouling and plugging by the use of an impingement device as a prefilter. (Author summary modified)

35513

Tearle, Keith A.

POLLUTION CONTROL AT ANGLESEY ALUMINIUM. Pollut. Control, 1971:14-15, Sept. 1971.

Control methods for the reduction of emissions of carbon dioxide, carbon monoxide, fluorides, sulfur dioxide, and dust particles (alumina and carbon) from aluminum smelters are reviewed. Fume control was effected by exhaust ventilation hoods, cyclone dust collectors, wet scrubbers, and special precoated fabric filters. The filter plant, dust disposal techniques, safety controls, maintenance, post-filtration exhaust, and liquid effluent plant are discussed.

36405

Nelson, L. B. and J. C. Barber

WILL EAGERNESS FOR POLLUTION CONTROL AFFECT FERTILIZER MARKET? Croplife, 1970:25-28, Jan. 1970.

Depending on the kind of plant or complex, atmospheric emissions from fertilizer plants and ancillary facilities include fluorides (essentially as silicon fluoride), sulfur dioxide, nitrogen oxides, free ammonia, ammonium chloride, and various dusts. Such emissions can be controlled adequately by using electrical precipitators, condensers, mechanical dust collectors, and scrubbers. Recovery and reuse of plant nutrients and salable by-products from emissions and liquid wastes add measurably toward improving efficiency and reducing the cost of pollution abatement. Fluoride can be economically recovered as fluosilicic acid or fluosilicate salts at many locations.

36475

Minakami, M., S. Oote, A. Matsuura, and I. Ogawa

EXHAUST AMMONIA TREATMENT IN A FERTILIZER PLANT. (Bohiryo kojo no haishutsu ammonia ni tsuite). Text in Japanese. Taiki Osen Kenkyu (J. Japan Soc. Air Pollution),

6(1):181, 1971. (Presented at the National Council Meeting of Air Pollution Studies, 12th, Nagoya, Japan, Oct. 27-29, 1971.)

Among pollutants identified in the exhaust (ammonia, sulfur dioxide, chlorides, fluorides, sulfates, and phosphates), NH3 showed extremely high concentration. The source of such high ammonia concentration was traced to a small amount of by-product, ammonium orthophosphate which readily decomposes at 100 C, giving ammonia. A substantial reduction in ammonia concentration was achieved by lowering the pH value of scrubber liquid. By this treatment, the ammonia concentration was reduced from 660 ppm to 6.60 ppm; however, the concentration of other oxidative gases was slightly increased.

36532

Paulus, Harold J. and Cort Platt

AIR POLLUTION CONTROLS IN THE SMALL ELECTROPLATING SHOP. Plating, 59(1):12-14, Jan. 1972. 5 refs.

Methods of controlling solvent losses, acid gases, acid aerosols, and alkaline aerosols from electroplating are outlined. The simplest solvent control method is to substitute alkaline or emulsion cleaning for vapor degreasing with trichloroethylene and perchloroethylene solvents. Where the solvents are used, losses are reduced by proper design, location, and operation of the vapor degreaser and by an activated carbon adsorption system. The acid gases are produced during the pickling or descaling of metal before plating, they include nitrogen dioxide, nitrous oxide, hydrogen chloride, hydrogen fluoride, and hydrogen sulfide. For the small plating shop, the best control method is the packed tower. Chromic acid and sulfuric acid mists and alkaline aerosols are controlled at the tank surface by foam blankets of floating plastic shapes, while mist and aerosols are removed from the ventilation system by spray scrubbers. If the acid and alkaline ventilation systems are combined, one scrubber can remove both materials.

36552

Smith, Peter V.

ADVANCEMENT IN THE CONTROL OF PARTICULATES. Tennessee Univ., Knoxville, Proc. Ind. Air Pollut. Control Conf., Annu., 1st, Knoxville, Tenn., 1971, p. 56-71. 6 refs. (April 22-23.)

In addition to particulate control, the familiar collectors such as the precipitator, scrubber, mechanical collector, and fabric filterhouse can also remove gaseous emissions such as sulfur oxides, nitrogen oxides, chlorine, and fluorine. The precipitator can remove enough particulate matter to enable the gas removal device to operate effectively, independently of the entrained particulate matter which could be detrimental to its operation. In many instances where upgrading fly ash removal of an existing boiler is necessary to meet new regulations, the use of scrubbers is preferred because their compact size is compatible with the amount of available land area. The most recent innovation in the use of electrostatic precipitators is the application of the hot precipitator to utility boilers firing low sulfur coal. In the aluminum industry, electrostatic precipitators have been used on prebake potlines. Packaged, low energy, venturi-slotted type scrubbers have been successfully applied to remove particulate emissions from apartment house incinerators.

36716

Sherwin, K. A.

EFFLUENTS FROM THE MANUFACTURE OF SUPERPHOSPHATE AND COMPOUND FERTILIZERS. Chem. Ind. (London), vol. 41:1274-1281, Oct. 8, 1955. 6 refs. (Presented at the Society of Chemical Industry, Symposium on the Prevention of Atmospheric and Water Pollution in the Chemical Industry, London, England, April 4-5, 1955.)

Current control practices for treating waste gases, solids, and liquids from processes involved in manufacturing superphosphate fertilizers are described and evaluated. In sulfuric acid production by the chamber process, correct loading of nitric oxides in the initial stages is the most effective control against excess sulfur oxides or nitrogen oxides in tail gases. Scrubbers are used to control exit gas acidity in acid production by the contact process. Gaseous fluorine effluents from superphosphate production are also controlled by various scrubbing systems. Most dust from the exit gases of granular fertilizer manufacture, particularly from drying and cooling operations, is removed by high-duty cyclones, sometimes supplemented by scrubbers. Emissions from phosphoric acid and triple superphosphate production are adequately controlled by methods similar to those used in ordinary superphosphate plants, allowing for a greater dilution of the gases. Disposal of solid gypsum is of increasing concern.

36755

Cook, C. C. and G. R. Swany

EVOLUTION OF FLUORIDE RECOVERY PROCESSES. ALCOA SMELTERS. Tennessee Univ., Knoxville, Dept. of Civil Engineering, Proc. Ind. Air Pollut. Control Conf., Annu., 1st, Knoxville, Tenn., 1971, p. 145-157. (April 22-23.)

Fluoride recovery processes developed by Alcoa and various techniques of pollution control instituted in their aluminum plants are reviewed with respect to early history, development of gas cell technique and treatment facilities, dry process development, and the Alcoa-398 process. Wet scrubbers to capture gaseous fluorides, fume collection equipment, electrostatic precipitators, and filter bags comprise most of the control systems. The Alcoa-398 process consists of a fluidized bed of alumina, dust collector, conveyors for alumina transport, and storage space. Typical investment and operating costs are discussed.

37080

Tomany, James P.

VALUABLE BY-PRODUCTS RECLAIMED THROUGH AIR POLLUTION CONTROL. Aerotec Ind. Rev., 5(4):9-12, 1965.

A serious difficulty in preventing fertilizer industry emissions of hydrogen fluoride, silicon tetrafluoride, particulate matter, and ammonia with a conventional-type wet scrubber is the formation of gelatinous material during operation, causing plugging of the scrubber. Types of apparatus used in this industry include a turbulent-contact absorber and an aeromix scrubber. The absorber consists of a tower containing one or more stages of low-density spheres. When gas and liquids are introduced, the spheres are thrown into random, turbulent motion through the reaction zone, and this buffeting action promotes intimate contact between the gas and liquor phase. The scrubber is an improved version of the standard venturi-type wet scrubber. Design features of the absorber and aeromix scrubber are discussed with particular reference to the production of phosphoric acid, triple-superphosphate, and ammonium phosphate.

37115

Kholin, B. G., L. M. Chernyak, and S. A. Kolesnikov

TEST OF FAN ATOMIZER FOR ABSORPTION OF FLUORINE-CONTAINING GASES IN THE PRODUCTION OF SUPERPHOSPHATE. Sov. Chem. Ind. (English translation

from Russian of: Khim. Prom.), no. 4:286-287, April 1971. 13 refs.

Fine-dispersion atomization of the liquid is one of the most powerful means of intensifying mass-transfer processes between a liquid and gas. The intensity of the absorption process with fine atomization can be increased by using rotating perforated cans, particularly with outflow openings of relatively large diameter. This makes it possible to create a reliable, highly productive, and economic design for a fan liquid atomizer which then can be used to absorb fluorine-containing gases in the production of superphosphate.

37164

Oote, S., Y. Nakagawa, M. Minakami, and I. Ogawa

EXHAUST FLUORIDES FROM GYPSUM PLANTS. (Sekko kojo no haishutsu fukkabutsu ni tsuite). Text in Japanese. Taiki Osen Kenkyu (J. Japan Soc. Air Pollution), 6(1):187, 1971. (Presented at the National Council Meeting of Air Pollution Studies, 12th, Nagoya, Japan, Oct. 27-29, 1971.)

The hydrogen fluoride emission from a rotary kiln used in the manufacture of plaster of Paris was greatly reduced by a simple modification of the procedure. The colorimetric measurements indicated the variation in HF concentration during the processing, and that HF concentration was greatly reduced by the addition of neutralizing agents. By the addition of up to 0.50% of neutralizing agent, the HF concentration was markedly reduced from 81.8 ppm to 0.95 ppm. The relationship between HF concentration and pH was also investigated, so that the effect of pH on the product could be controlled.

37293

THE INAUGURATION OF THE NEW ALUMINUM PLANT PECHINEY IN VLISSINGEN BY PRINCE BERNHARD OF THE NETHERLANDS. (Einweihung der neuen Pechiney Huette Vlissingen durch Prinz Bernhard der Niederlande). Text in German. Aluminium, 47(12):782-784, Dec. 1971.

The new aluminum plant with 256 furnaces in Vlissingen (The Netherlands) has not been equipped with a central waste air cleaning system. After extensive experiments in the wind tunnel, it was decided to install individual groups of ventilators and gas scrubbers. The 34 ventilators with which the plant has been equipped have a throughput of 30 million cu m/hr, each ventilator has a throughput of 63 cu m/sec. In the gas scrubbers, 30,000 cu m water are atomized/hr for binding the fluorine gases. The fluorine is precipitated and recovered and returned to the production process. Air monitoring stations both of the stationary and mobile type are in operation to a distance of 18 km from the plant. The costs for installation of this system amounted to 1.68 million dollars, the power consumption amounts to 90 million kWh/yr.

37402

Hachmann, H.

THE MERITS OF SYNTHETICS. (Die Verdienste der Kunststoffe). Text in German. Technica, 21(4):247-248, Feb. 1972.

In order to obtain the lowest possible quantity of harmful exhaust gases, modern vehicles preheat the combustion air. Synthetics such as glass fiber reinforced Ultramid are used as the material for the casings. Another example of the use of synthetics in the field of environmental protection is the scrubbing towers for the purification of waste gases from an aluminum plant. The walls and interior installations of the scrubbers are of glass fiber reinforced Palatal. The 38 m high towers have a gas throughput of 200,000 cu m/hr. The gas entrance temperature lies between 90 C and 120 C. In each scrubbing tower 300 kg fluorine and 600 kg sulfur dioxide are retained each day. The fluorine content causes the scrubbing fluid to become 2% hydrofluoric acid. The dust concentration in the gas causes the solid concentration in the scrubbing water to rise to 5%. The synthetic material is able to resist the aggressiveness of the scrubbing water. Experiments are presently under way to test the protective influence of Lupolen foils spread out over vegetable crops to shield them from the emissions by airplanes.

37509

Predikant, Hans H., Hermann Betz, and Johann Schaeffer

METHOD AND DEVICE FOR CLEANING INDUSTRIAL WASTE GASES. (Verfahren und Vorrichtung zur Reinigung von Industrieabgasen). Text in German. (UOP-Kavag, Gesellschaft fuer Luftreinhaltung m.b.H., Gondsroth bei Frankfurt am Main (West Germany)) W. Ger. Pat. 1,905,080. 15p., Aug. 13, 1970. (Appl. Feb. 1, 1969, 7 claims).

A new method and equipment for cleaning industrial waste gases containing fluorine and/or hydrofluoric acid are described. The waste gases are scrubbed with aeqeous hydrofluoric acid in a first scrubbing zone and with sodium lye in a second scrubbing zone. The run-off from the first scrubbing zone is recirculated to the first scrubbing zone until the hydrogen fluoride concentration has risen to between 3 and 5% by weight. The run-off from the second scrubbing zone is recirculated to the second zone for enrichment of the sodium fluoride. The two run-offs from both scrubbing zones are combined in a neutralization zone; the precipitated sodium fluoride is separated, and the base lye is returned from the neutralization zone to the first scrubbing zone. The two scrubbing zones are arranged above each other in a column. Water is injected into the first scrubbing zone in proportion to the volume reduction of the scrubbing fluid. Each scrubbing zone has its own entrance and exit. The run-off from the two zones is collected in containers with return connections to the respective scrubbing zones.

37536

LOW COST REMOVAL OF ORGANIC VAPOUR POLLUTANTS. Chem. Process. (London), 17(12):9, 11, Dec. 1971.

An economical control system for low concentrations of organic vapors combines adsorption on one of two activated carbon beds with air incineration (thermal or catalytic). The carbon beds operate on alternate adsorption/regeneration cycles: when one bed becomes saturated, it is removed and regenerated with heat provided by the incinerated gases. Since steam is not required for regeneration, the corrosive condensate is absent from the system. The estimated annual average cost of the system is $27,900 versus $46,100 for carbon adsorption with steam regeneration, and $77,400 for air incineration alone (with heat exchange). A modification of the process, using cascade adsorption, allows the solvent vapors to be recovered rather than incinerated. This alternative may also be preferred if combustion products from the process contain hydrogen fluoride, hydrogen chloride, and sulfur dioxide.

37544

Burkat, V. S., E. Ya. Tarat, V. A. Baevshii, E. M. Voronin, and M. T. Tsurenko

PURIFICATION OF ALUMINUM-INDUSTRY GASES IN A HOLLOW HIGH-SPEED SCRUBBER. Soviet J. Non-Ferrous Metals (English translation from Russian of: Tsvetn. Metal.), 10(9):61-63, Sept. 1969. 3 refs.

A pilot gas purifier consisting of an electric separator and a hollow scrubber with spray nozzles was tested for its ability to remove gaseous and solid fluoride compounds from exhaust gases at an aluminum plant. The efficiency of gas purification in the scrubber was determined at gas linear velocities of 3-7 m/sec, gas inlet temperatures of 40-50 C, and spraying densities of 20 and 30 cu m/sq m/hr. Spray density had a greater influence on the degree of hydrogen fluoride entrainment than a change in gas velocity. The degree of purification remained constant within the gas-velocity range tested, but increased with an increase in spraying density. An equation is given that predicts the performance of the hollow, high-speed scrubber under various operating conditions.

37603

Huenlich, Hans-Werner

HOW IMPORTANT ARE THE PROBLEMS OF ENVIRONMENTAL PROTECTION FOR THE BRICK AND EARTH ENGINEER. (Welche Bedeutung haben Probleme des Umweltschutzes fuer Steine und Erden-Ingenieure). Text in German. Tonind. Ztg, 96(1):21-23, Jan. 1972.

The environmental problems with which brick and earch engineers are confronted include the cleaning of waste gases and the reduction of dust emissions. The removal of sulfur dioxide closely followed by that of fluorine from the industrial waste gases have top priority. Applicable waste gas desulfurization methods seem to be available now after several setbacks. They are mostly based on the binding of the gaseous SO2 on fine-grained bases such as magnesium oxide, dolomite, caustic lime, lime hydrate or limestone present in suspended form or in the fluid-bed. No method for the removal of fluorine from the waste gases of fertilizer plants is available yet. The elimination of the fluorine emissions by aluminum plants has not been entirely solved yet either. The dust collection methods have reached a high level of achievement, so that dust elimination nowadays is mainly a problem of costs and of the disposal of the collected dust.

37745

Volfkovich, S. I., I. M. Boguslavskiy, S. B. Kazakova, N. S. Bogdanova, I. P. Khudoley, V. G. Voytsekhovskiy, T. V. Vovk, and Ye. A. Malysheva

PRODUCTION OF BIFLUORIDE-AMMONIUM FLUORIDE AND WHITE SOOT FROM OUTGOING FLUORINE-CONTAINING GASES IN THE PRODUCTION OF SUPERPHOSPHATES. (Polucheniye biftorida-ftorida ammoniya i beloy sazhy iz ftorsoderzhashchikh gazov superfosfatnykh proizvodstv). Text in Russian. Khim. Prom. (Moscow), no 12:22-24, 1971. 5 refs.

Laboratory and pilot-plant experiments were carried out to elaborate methods for the complex utilization of waste gases containing fluorine. Waste gases were absorbed by recycled ammonium fluoride solution containing 6-10% NH4F and 1-2% NH3. The solution thus obtained contained 15-20% ammonium silicon fluoride and 0.5-2% of H2SiF6. Excess ammonium hydroxide was used for neutralization which produced ammonium fluoride and SiO2. The pulp contained ammonium fluoride in concentrations of 15-20%. After agitation and cooling to 40 C, the liquid and solid phases were separated in four filters. The filtrate obtained on one of these filters was recycled to the absorption process. Three subsequent washing cycles were applied for SiO2, followed by the drying of the sprayed powder using high-temperature waste gases. The SiO2 thus obtained was used as additive to rubber products. The filtrate from the first filter, containing 15-20% ammonium fluoride, was subjected to two-stage condensation. A concentration of 60% was reached in the first stage, using atmospheric pressure, while the condensation was increased to 90% in the second stage, in applying a pressure of 380-420 Hg mm. After cooling and centrifugation to a residual humidity of 1.5-1.8%, a standard quality product was obtained.

37809

Kajitani, Eiji and Shoji Niida

EQUIPMENT FOR COOLING AND SCRUBBING CORROSIVE HOT GASES. (Einrichtung zum Kuehlen und Waschen korrodierender heisser Gase). Text in German. (Sumitomo Metal mining Co., Ltd., Tokyo (Japan)) W. Ger. Pat. 1,671,404. 4p., Oct. 14, 1971. 2 refs. (Appl. May 31, 1967, 3 claims).

The equipment includes a cylinder with outlets for gas and liquid in the lower part, and a top cover lined with an organic acid-proof material, which contains the gas inlet and the sprayers for the cooling and washing liquid. The cylindric part made of glass fiber reinforced thermoset is lined on the inside with a tissue resistent to solutions containing fluorine, and has a circular channel on its top edge for the cooling liquid. The top cover is separated from the cylindric part by a corrosion-resistant flexible foil to prevent stresses. The admission temperatures range from 100 to 300 C, and the gas to be cleaned may contain sulfur dioxide, fluorine, and chlorine.

37914

Achorn, Frank P. and J. S. Lewis, Jr.

EQUIPMENT TO CONTROL POLLUTION FROM FERTILIZER PLANTS. Ag Chem Commer. Fert., 27(2):10-14, Feb. 1972. 5 refs. (Presented at the Fertilizer Roundtable, Memphis, Tenn., 1971.)

The efficiency and applicability of various control methods for use in fertilizer plants are reviewed. The use of impingement-type scrubbers, wet cyclones, venturi scrubbers, packed bed scrubbers, and some process modifications to control emissions of ammonia, chlorine, fluorine, phosphoric acid, and dusts from specified processes is examined.

38082

Schwegmann, J. C. and L. Leder

PURIFICATION OF ELECTROLYSIS-FURNACE FLUE GAS FROM ALUMINUM FOUNDRIES. (Abgasreinigung der Elektrolyseofen-Abgase von Aluminum-Huetten). Text in German. Luftverunreinigung, 1969:17-20, Oct. 1969.

A technique for the purification of waste gases emitted from the electrolytic cells of aluminum manufacturing plants is presented. The problems of withdrawing the gases from each cell individually or from the building housing the cells are reviewed. The best method of removing the gases from each cell is individual encapsulation. The exhauster must be designed to leave sufficient access to the cells but simultaneously prevent any emission of the waste gases into the work shop. A negative pressure must be maintained in the exhauster spanning the surface of the cell; removable sheet steel plates are installed on the sides. In cases where individual withdrawal is not feasible, centralized cleaning, using ventilators and scrubbers, is possible. Due to the great volumes of air to be drawn off in centralized cleaning, the cleaning efficiency of the diluted gases withdrawn centrally is much lower than that of the concentrated gases withdrawn individually. The process for individual withdrawal is reviewed. The control equipment consists of an exhaust system for waste gas drawing, cyclones for dust removal, scrubbers for removal of gaseous fluorine, and high stack discharge.

38115

Hisatsune, Takeo

DUST COLLECTION OF HIGH TEMPERATURE GASES BY WET-TYPE AND BAG FILTER COLLECTORS. (Shishiki oyobi baggu firuta ni yoru koon gasu no shujin). Text in Japanese. Nenryo Oyobi Nensho (Fuel and Combustion), 39(1):40-46, Jan. 1972.

The collection of dusts from high temperature exhaust gases is problematical due to the corrosive nature of gases, high temperature, and the high cost of operation and maintenance of the systems. The previously, widely used wet dust collectors had only 70 to 80% collection efficiency, and damages to fans, caused by accumulation of dust, were quite frequent. More recently, the wet dust collector has been exclusively used for high temperature gas fume collection in foundry cupolas. The principle, mechanism, and effect of the venturi scrubber are explained. A venturi rod hydrofilter is discussed with illustrations. This is a relatively simple structure consisting of a number of wet pipes over which the high temperature gas fume is passed. Vapor is created on the surface of the pipes and mingles with the high speed gas current, colliding into dust particles and collecting them. Bag filters are most frequently used for dust collection of high temperature gases. Different filters are used according to the type of gas; problem gases are steam, sulfur dioxide, carbon monoxide, chlorine gas, and fluoride gas. Various types of corrosion and cooling methods are discussed. One type of dust tube collector is discussed with illustrations. The gas enters from the hopper and coarse dusts collide into a baffling board and settles. The gas current enters the filter bag and the cleaned air goes out from the top. The dust accumulation on the filter fabric is periodically shaken off by the horizontal movement of shaker pipes and the vertical movement of the bags. Excellent results are achieved. Various types of bag filters are compared in a table.

38188

Zhulin, N. V. and A. A. Komlev

USE OF FLOCCULANTS FOR PRECIPITATING PARTICLES IN GAS PURIFICATION SOLUTIONS. (Primeneniye flokulyantov dlya osazdeniya chastuts v rastvorakh gazoochistki). Text in Russian. Tsvetny. Metal., 8(44):36-37, 1971. 3 refs.

The effect of flocculants on the settling of suspended solids from sodium bicarbonate scrubber solutions used after the electrostatic precipitation of noxious gases from aluminum cells was examined. The solution contained approximately 25 g/l sodium fluoride, 53 g/l sodium carbonate and sodium bicarbonate, 47 g/l sodium sulfate, and 30 g/l suspended solids consisting of about 80% cryolite, aluminum fluoride, magnesium fluoride, and calcium fluoride and about 15% of calcination loss products, i.e., unburned coke and pitch. Decreasing the solution sodium sulfate concentration from 52 to 32 g/l and increasing the temperature from 20 to 50 deg increased the settling rate by 50 and 100%, respectively. Soap chips, sodium oleate, oleic acid, tall oil and its hydrolysis products, and hydrolyzed polyacrylamide accelerated the settling; of these, 30 mg/l of the hydrolyzed polyacrylamide was the best additive.

38299

Bridge, Alan C., Joseph Jaffe, and David S. Mitchell

DESULFURIZATION PROCESS EMPLOYING UPFLOW OIL AND HYDROGEN. (Chevron Research Co., San Francisco, Calif.) U. S. Pat. 3,620,968. 4p., Nov. 16, 1971. 6 refs. (Appl. Oct. 31, 1968, 1 claim).

A process for the catalytic hydrodesulfurization of hydrocarbon oils, particularly those containing a substantial proportion of material boiling above 500 F and containing 0.5-10% by weight of organic sulfur, is presented. The major advantages of the process over prior hydrodesulfurization processes lie in improvements of the activity and stability of the catalyst and of flow arrangements. The hydrocarbon feedstock, a major portion of which is in liquid phase during contact with the catalyst, is desulfurized by passing the oil and hydrogen upward in a cocurrent flow through at least one fixed bed of catalyst contained in a desulfurization reactor. The catalyst comprises pellets or other particles of alumina cogelled with a group VI hydrogenating component, a group VII hydrogenating component, group IV metal phosphate particles dispersed in the catalyst, and fluorine. The upflow oil and hydrogen operation with a cogel catalyst provide for higher activities and low initial fouling rates. (Author abstract modified)

38439

Zizka, Jaroslav, Stanislav Servus, and Zdenek Cvrk

EQUIPMENT FOR REDUCING THE QUANTITY OF HARMFUL GASEOUS, LIQUID AND SOLID EXHALATIONS. Czech. Heavy Ind. (Prague), no. 11:2-10, 1971.

Performance data are given for several types of apparatus for removing harmful gases, liquids, and solids from industrial waste gases. Included are a foam-type separator for noncorrosive gases with a dust content up to 400 g/cu m; a current-type separator for highly dispersed liquid or solid aerosols; a separator for relatively coarse fibrous particles in a mixture with particles about 1 micron; and a two-stage Trition separator for solid or liquid aerosols with a particle size less than 1 micron. Also described are foam-type absorbers for soluble gaseous compounds such as hydrogen chloride and hydrogen fluoride or for aerosols of sulfuric acid, nitric acid, and sodium hydroxide; an overflow- type absorber for more demanding absorption processes; a fibrous filter for oil mists; a separator and retainer of minute liquid aerosols, and a combustion device that totally oxidizes combustible substances in waste gases to carbon dioxide and water. The rated gas capacities of different models of each item are given together with the application possibilities of some of the equipment.

38445

Kraft, Guenther and Heinz Beck

PROCEDURE FOR THE REMOVAL OF FLUORINE FROM WASTE GASES OCCURRING IN ALUMINUM FUSION ELECTROLYSIS SHOPS. (Verfahren zur Entfernung von Fluor aus Abgasen, insbesondere solchen der Schmelzflusselektrolyse des Aluminiums) Text in German. (Metallgesellschaft A. G., Frankfurt, (West Germany)) W. Ger. Pat. 1,567,660. 3p., Dec. 23, 1971. (Appl. March 29, 1963, 2 claims).

Removal of fluorine from gases developed in the process of fusion electrolysis in aluminum plants is achieved by treatment with lithium containing washing solutions. The washing solutions should include lithium (hydroxide), sodium, and aluminum in proportions so that the fluorine will be precipitated as an insoluble Li-Na-Al-F-complex. Optimum pH of the washing solution for this reaction is 3, but satisfactory results are achieved as long as the pH is kept below 6.

38476

Dreyhaupt, Franz Josef

COMBATING THE SO2 EMISSION ACCORDING TO THE STATE OF THE ART. (Kampf der SO2-Emission nach dem Stand der Technik). Text in German. Umwelt (Duesseldorf), 2(1):36-39, Feb./March 1972. 15 refs.

Sulfur dioxide contained in the atmosphere has a toxic affect on man, plants, and materials. Pines die in the Ruhr Valley because of the sulfur dioxide; its effect on these trees was probably enhanced by fluorine also present in the atmosphere. Plants begin to show signs of injuries at an annual average concentration of 85 micrograms SO2/cu m air. Materials begin to show serious signs of deterioration at an average annual SO2 concentration of 345 micrograms/cu m. Considerable physical effects on man have been observed at SO2 concentrations of more than 300 micrograms/cu m lasting for 3 or 4 days and of more than 115 micrograms/cu m air over the year. The existing maximum allowable emission concentration for SO2 (0.4 mg SO2/cu m air) in the Federal Republic of Germany is too high. Considerable plant injury at this concentration is not impossible. Unfortunately, the SO2 emission will continue to rise in future - at least in the state of North Rhine Westphalia. Measures for reduction of the SO2 emission include the use of low-sulfur fuel oil (1% sulfur) and the desulfurization of the waste gases. Of the various desulfurization methods the Grillo-process is ready for practical use. It is estimated that this process used in oil-fired power plants will raise the power costs by 0.1 cents/kWh.

38504

Waki, Koichi, Tadashi Suzuki, and Toshinobu Mitsui

PROCEDURE AND EQUIPMENT FOR THE REMOVAL OF NOXIOUS CONTAMINANTS FROM GASES. (Verfahren und Vorrichtung zum Entfernen von in einem Gas enthaltenen schaedlichen Verunreinigungssubstanzen). Text in German. (Showa Denko K. K., Tokyo (Japan)) W. Ger. Pat. Appl. 2,116,996. 29p., April 7, 1971. (9 claims).

The procedure and equipment for removing contaminants, e.g., fluorine, chlorine, sulfur dioxide, and hydrogen cyanide, from waste gases by passing them over a packed bed sprayed with an absorbing solution of sodium carbonate or sodium hydroxide are described. Thin plastic plates were arranged in a horizontal line across an absorption tower and sprayed with the Na2CO3 solution to an average deposition thickness of 0.015 mm. The wast gas was cooled and scrubbed, and the gas, containing 0.01% sulfur, 2-3% oxygen, 5-10% carbon dioxide, 0.005% nitric oxide, 20-25% moisture, and nitrogen, was passed through the tower with an entrance temperature of 20-25 C. The cleaned gas left with an SOx concentration of 0.0005%. After 20 hr of continuous operation, SOx concentration increased to 0.001%; the waste gases were then passed through another tower, while the first tower was regenerated by cleaning the packed bed with water or a solution of the absorbing agent. Waste gases containing 40 mg/cu m of chlorine gas were passed through the tower at 200 cu m/min and were cleaned to a residual hydrogen chloride concentration of 3 mg/cu m.

38587

Wolfram, Walter

DEVELOPMENT OF A NEW FLUORINE ABSORPTION PROCEDURE FOR THE REMOVAL OF SILICON TETRAFLUORIDE FROM SUPERPHOSPHATE PLANT WASTE GASES. (Die Entwicklung einer neuartigen Fluorabsorption fuer die Abscheidung des Siliziumtetrafluorids aus den Abgasen von Superphosphatanlagen). Text in German. In: Technik und Umweltschutz Luft-Wasser-Boden-Laerm. Kammer der Technik, Brennstofftechnische Gesellschaft in der Deutschen Demokratischen Republik (ed.), Leipzig, VEB Deutscher Verlag fuer Grundstoffindustrie, 1972, p. 75-89. 18 refs.

Maximum separation of silicon tetrafluoride from the waste gases of superphosphate plants is required. The actually used fluorine absorption equipment such as spray towers, spray chambers, or combinations fail to comply with the requirements of modern air hygiene. To obtain commercially utilizable waste products with efficiencies above 99.5%, a fully continuous and automatic fluorine absorber with a modified lattice bottom was developed and tested at the Coswig plant of VEB Stickstoffwerk Piesteritz (East Germany). Here, silica and silicofluoric acid are discharged continuously, and large phase contact area is provided. Thermodynamic and kinetic problems of silicon tetrafluoride absorption were studied, and single-stage absorption was sufficient for a silicofluoric acid concentration of 17%. The absorber consists of a round, rubber-lined steel tower with bottom inlet for the waste gases with fluorine concentrations of 8-12 g/cu m. The gas passes through four consecutive lattice bottoms made of brass, at a rate of 25,000 cu m/hr. The silicofluoric acid formed drops down through the bottoms at a rate of 800 l/min and sq m of tower cross-section area. A stable dynamic layer of 120 mm thickness is formed upon the bottoms, providing a large contact area. The water consumption is 1-1.5 cu m/hr. The silicofluoric acid is obtained in a concentration of 15.17% hydrogen while the purified gas contains fluorine in a concentration of 20-30 mg/cu m. The pressure drop within the absorber lies at 70-80 mm of water column. An automatic concentration control is planned. The pilot equipment has been operating successfully for 2 yrs.

38593

Massonne Joachim

STATE OF THE ART AND DEVELOPMENT OF INDUSTRIAL FLUORINE CHEMISTRY. (Stand und Entwicklung der industriellen Fluorochemie). Text in German. Chemiker Z. (Heidelberg), 96(2):65-75, Feb. 1972. 79 refs.

Electrolytic aluminum production is by far the largest consumer of inorganic fluorine compounds. In 1970, the Federal Rupublic of Germany produced 309,000 t of aluminum for which 9000 t of AlF3 and 8000 t of Na3AlF6 were used. Despite the present stagnation of aluminum consumption, considerable capacity increases are expected for Europe and Japan. For reducing fluorine emissions by these plants, expensive waste cleaning facilities are installed. An aluminum plant producing 100,000 tons of aluminum/annum, 5 to 6 t of HF are emitted daily in addition to considerable quantities of dust; at the Soederberg anodes, tar vapors, soot particles, and sulfur dioxide are emitted. In the so-called open furnaces (e.g., Alsuisse), type the waste gases are passed through rooftop scrubbers prior to discharge; 50% of the dust and 90% of the F are removed. The uncleaned gas usually arrives at the scrubber with 5 mg F/cu m. In furnaces with Soederberg anodes, the waste gases are collected and burned to eliminate tar vapors. They are then passed to cyclones or electrostatic precipitators for dust separation and to the scrubber for washing out the gaseous fluorine compounds. A dry method for cleaning such gases has recently been introduced wherein the waste gas is treated with Al2O3. Dust and HF are retained. The HF and dust-laden clay then goes to an electrolytic bath. The method is disadvantageous in that the solid residues must be dumped.

38775

Ryaguzov, V. N. and I. V. Kaydalov

EFFECT OF THE METHOD OF STOPPING THE ANODE EFFECT ON THE POLLUTION OF THE ATMOSPHERE WITH FLUORINE. (Vliyaniye sposoba grsheniya anodnogo effekta na stepen zagryazneniya atmosfery ftorom). Text in Russian. Tsvetn. Metal., 44(8):26-28, Dec. 27, 1971. 6 refs.

Fluorine salt losses and abatement of air pollution with fluorine from aluminum producing plants can be achieved by

substituting the use of wood pulp or other hydrogen containing compounds with compressed air in the extinguishing of the anodic effects. However, the wide use of this procedure was prevented because of the explosion hazards involved, if the air included humidity drops. An air drying device should be applied before its use for this purpose. Since each hydrogen atom introduced into the electrolyte system produces an emission of one fluorine atom, and the carbon constituent of the wood pulp produces contamination of the electrolyte and thus increases its electrical resistance, the advantage of the compressed air use is emphasized.

38874

Fialkov, Yu. G., M. L. Cherkasskiy, V. S. Malts, and B. P. Gromov

INDUSTRIAL HIGH-SPEED HOLLOW SCRUBBER FOR ALUMINUM MANUFACTURING-GENERATED GAS CLEANING. (Promyshlennyy polyy skorostnoy skrubber dlya ochitski gazov alyuminiyevogo proizvodstva). Text in Russian. Tsvetn. Metall., no. 12:28-31, Dec. 1971. 4 refs.

Scrubbers with diameters exceeding 5 m used in electrolysis shops were investigated. Before scrubber treatment the gas to be cleaned contained, per N cu m, 10-30 mg hydrogen fluoride, 30-100 mg dust, and 10-60 mg tar. The scrubber was sprayed with soda solution as an absorbing agent. Hydrogen fluoride absorption was dependent on the linear gas velocity and the spray density. The efficiency could be influenced by the site and direction of the spray. Spraying from the topside gave the best result up to a gas speed of 5 m/sec. The effects of the spray density were studied under various spraying conditions. Efficiencies of 97.5-98.0% were reached with a density of 37 cu m/sq m.hour. Single-stage dust separation and scrubbing were applied in the hollow scrubber. Increased gas speed and spray density resulted in increased efficiency, while the nozzle placement had only a slight influence. The residual dust concentration was 30-60 mg/N cu m. Efficiency for total dust was 73% with a gas speed of 3.3 m/sec and a spray of 30 cu m/sq m.hour. Efficiencies above 90% can be reached with appropriate gas velocities and spray density. The drop separator had a hydraulic resistance of 15-20 kg/sq m.

39104

CLEANUP PAYS OFF FERTILIZER PLANT. Environ. Sci. Technol., 6(5):400-401, May 1972.

Farmland Industries of Bartow, Florida, spent nearly a million dollars a couple of years ago to install a fluorine recovery system in its 22 million dollar phosphate fertilizer plant. During the first full year of the system s operation, Farmland recovered more than 5000 tons of fluosilicic acid--a by-product it had previously been wasting--and sold every ounce of it. The fluorine recovery equipment is not complicated and works well. The tops of the evaporators were simply unbolted at a flange and a water recirculation system was installed in the exit gas stream. As the phosphoric acid is successively concentrated in the evaporator units, fluorine-containing off-gases are concentrated in an aqueous solution. With the recirculation system, a fluosilicic acid concentration of about 20% is obtained.

40251

Hartig, Rufus G.

METHODS FOR PREVENTION OF SURFACE WATER CONTAMINATION AND AIR POLLUTION BY FLUORINE COMPOUNDS FROM PHOSPHATE PLANTS. (Assignee not given.) U. S. Pat. 3,642,438. 12p., Feb. 15, 1972. 9 refs. (Appl. April 15, 1969, 5 claims).

A process is described for the elimination of the fluorine contamination of surface waters and other pollution by fluorine compounds from phosphate plants, and for recovery of fluorine as hydrofluosilicic acid. The processes involve the separation of fluorine compounds from waste gases by absorption-desorption with sodium fluoride, barium difluoride, or potassium fluoride, and absorption of silicon tetrafluoride in water. Hydrofluoric acid may also be recovered in the process. A principle object of the invention is the control of fluorine content of gypsum pond waters. Scrubbers, filters, and settling tanks are part of the process.

40381

Haenig, Gernot and Klaus Husmann

THE GRILLO-AGS PROCESS FOR DESULFURIZATION OF WASTE GASES. (Das Grillo-AGS-Verfahren zur Entschwefelung von Abgasen). Text in German. Z. Erzbergbau Metallhuettenwesen, 25(4):175-181, April 1972. 13 refs.

The Grillo-AGS desulfurization method, which is in its eighth year of development, is based on wet absorption using mixtures or compounds of magnesia and manganese oxides as absorbents. The efficiency of the method was tested under the operating conditions of an oil-fired steam boiler. At the same plant (8000 cu m/hr capacity), tests were conducted to determine whether, apart from sulfur dioxide a selective removal of sulfur trioxide at temperatures between 300 and 500 C is feasible. While in earlier experiments the absorption was carried out in spacious containers with diameters of 3 to 4 m and with gas residence times of several seconds in two stages, it later became feasible to desulfurize a waste gas flow of 27,500 cu m/hr in a single absorption tube 5 m long 0.8 m in diameter with an efficiency of more than 90%. At a pressure loss of only 50 mm water the gas residence times were below 0.5 sec. This is due to the extraordinary effectiveness of the magnesia-manganese oxide mixture which requires much shorter residence times than a pure magnesia oxide suspension. The coke filter of earlier experiments was replaced by a lamellar droplet separator. The original throughput of fresh absorption mass of 1.6 to 1.8 g/g SO2 could be reduced to less than 1.5 g mass/g SO2. The absorption of SO3 at temperatures of about 350 C is almost total and that of fluorine is 70%.

40414

Gelperin, N. I. and V. M. Tarasov

EQUIPMENT FOR CLEANING OF ALUMINUM ELECTROLYSIS SHOP-EMITTED GASES: EFFICIENCY AND INTENSITY OF OPERATION. (Ob intensivnosti i effektivnosti apparatov dlya ochistki otkhodyashchikh gazov alyuminiyevykh elektrolizerov). Text in Russian. Zh. Prikl. Khim., 45(1):70-75, 1972. 9 refs.

Results of a comparative study of equipment for the removal of gaseous hydrofluoric acid, dust, and tar from aluminum electrolysis shop gases are described. Soda solution was used as absorbent in all cases. The relative characteristics of the different equipment were determined on the basis of efficiency, mass transfer, and energetic parameters, separately for electrolysis shops with lateral and top power supply. The efficiency for gaseous hydrofluoric acid was fairly high (90-98%), while the gas flow rates varied within a wide range of 0.9-6 m/sec. The rate of mass transfer, determining both the relative productivity and the efficiency, was highest in fluidized-bed scrubbers (18-23.4 m/sec), and lowest in scrubbing chambers (1.2 m/sec). The energetic parameters were lowest for

fluidized-bed and high-speed scrubbers, and highest for cyclones. The rate of mass transfer for dust was best in fluidized-bed scrubbers and worse in foaming equipment (0.36 m/sec, energetic parameter 500 kg/sq m) which were hardly suitable for highly dispersed dust. The rate of mass transfer for tar products was best in fluidized-bed scrubbers and hydrodynamic dust collectors. Fluidized-bed scrubbers, satisfying sanitary standards in single-stage operation, were best regarding both intensity and efficiency for gases from electrolysis shops with lateral power supply, while none of the designs investigated was capable of meeting such standards in single-stage operation for electrolysis shops with top power supply.

40712

Haenig, Gernot and Klaus Husmann

THE GRILLO-AGS PROCEDURE APPLIED FOR WASTE GAS DESULFURIZATION. (Das Grillo-AGS-Verfahren zur Entschwefelung von Abgasen). Text in German. Erzmetall, 25(4):175-181, 1972. 13 refs.

The Grillo-AGS wet absorption procedure, developed for the removal of sulfur oxides from waste gases in 1969, as well as related pilot plant experiments, realized equipments, and possible uses are described. The absorbent, formed by mixtures or compounds of magnesium and manganese oxides, is sprayed into the path of the waste gas flow in a reactor, and after being recirculated several times, the spent suspension is removed for drying. The dried matter, containing 17 to 21% of sulfur in the form of magnesium sulfate or sulfite, is then subjected to thermal regeneration in a separate, central roasting furnace, by adding a reducing agent such as oil, natural gas, sulfur, or coal. The roasting gas formed contains 5-7% of the sulfur dioxide by volume, and can be reprocessed to sulfuric acid in conventional equipment. A pilot plant, designed for an oil-fired steam boiler, was composed of a 5 m long tube of 0.8 m diameter. It had an efficiency of above 90% at a capacity of 27,500 cu m/hr, while the sulfur dioxide and sulfur trioxide concentrations in the waste gas were 1.3-2.5 g/cu m and 50-300 mg/cu m, respectively. The separation of the suspension from the waste gas was made in a tower, followed by a lamellar droplet separator with an over-all efficiency of 99.5%. The contact time was less than 0.5 sec, and the specific expenditure lay at 1.5 g/g of SO2. Rapid hydratation of the absorbent below pH 7 was observed. The SO3 removal at 350 C was nearly quantitative, and the efficiency for fluorine was 70%. Full-size industrial equipment have efficiencies of 30-95%, and several units are preferably connected to a central, separate regenerator. The total costs of the SO2 absorption at an oil-fired power plant lie in a range of .04-.07 cents/kWh (1.9 million cu m/hr, 3.5 g of SO2 per cu m). The Grillo-AGS procedure can be applied to thermal power plants, remote heating plants, and metallurgic plants. Large regenerator plants with a capacity of 200,000 tons of sulfuric acid should be designed.

40892

Weineck, Hans and Robert Goergen

ENVIRONMENTAL PROTECTION AND STEEL INDUSTRY - PROBLEMS AND SUCCESSES. (Umweltschutz und Stahlindustrie - Probleme und Erfolge). Text in German. Stahl Eisen (Duesseldorf), 92(6):232- 237, March 16, 1972. 13 refs.

Problems and achievements within the field of environmental pollution controls in the steel industry are reviewed. New technologies for steel production are viewed no longer solely from a point of economy but also from a point of how harmful they are to the environment. The share of the total emission of gaseous and particulate matter from steelmaking processes is 14% as compared with that of traffic at 42%. At the first stage of steel production, the preparation of the raw material, dusts are emitted. The waste gases from sintering plants contain sulfur dioxide and fluorine compounds. The blast furnace waste gases no longer pose problems since they can be cleaned to residual dust concentrations of 3-5 mg/cu m. Emission from steel plants have decreased to 10% in 1969-1970. Despite enormous production increases, the dust sedimentation decreased from 313,000 to about 245,000 tons. The SO2 emission concentration has also decreased between 1963 and 1969 from 0.24 to 0.15 mg/cum. The major cause of pollution reductions is process and design modifications of furnaces.

41378

Klimecek, Rostislav

THE PROBLEM OF REMOVAL OF INDUSTRIAL EXHALATIONS. (Problem odstranovani prumyslovych exhalaci). Text in Czech. Chem. Prumysl (Prague), 21(12):615-618, 1971. 6 refs.

Current concentrations of gaseous effluents emitted by the Czechoslovak chemical industry, control methods used, and desulfurization processes of gaseous effluents from thermal power plants were investigated. Total emission from chemical factories was 20,000 tons of sulfur dioxide and 3500 tons of sulfur trioxide; thermal power plants contributed approximately two million tons, with an additional 220,000 tons from the transportation industry, 150,000 tons from metallurgical plants and 400,000 tons SO2 from home heating installations. Control measures instituted by plants of the chemical industry included washing of end gases variously with sodium hydroxide solutions, ammoniacal solutions, sodium becarbonate, and by catalytic oxidation to SO3 and its subsequent absorption. While these various technologies have been satisfactory for the chemical industry, they are not adequate for the thermal power plants due to the nature of the end gases and because of the problem of final disposition of the desulfurization by-products. Washing towers which could process several million cu m waste gases/hour containing fly-ash and having a temperature of 180 C and which could purify them so that they are hot enough to disperse fast enough in the atmosphere have not yet been developed. Foreign technologies cannot be applied because combustion gases in Czechoslovakia are of different composition. Under generally prevailing conditions, recovery of sulfur is more economical than desulfurization with gas purification as an end. Other pollutants emitted amount to 9500 tons carbon disulfide, 13,500 tons hydrogen sulfide, 10,500 tons nitrogen oxides, 2500 tons chlorine, 500 tons hydrochloric acid, and 500 tons fluorine. In the case of some large plants, recovery of pollutants and their recycling is more advantageous than liquidation (catalytic reduction of nitrogen oxides in nitric acid plants).

41418

McLeod, J., L. Ferrari, and H. Scheltema

CONTROL OF ACID FUME FROM DROSS REPROCESSING. Australian Chem. Process. Eng. (Sydney), 25(2):13-16, Feb. 1972. 6 refs. (Presented at the Royal Australian Chemical Institute and Institution of Engineers, Joint Symposium on Chemical Process Waste Disposal, Sydney, Australia, Oct. 12, 1971.)

The process of aluminum melting for casting into billets or castings usually involves the use of fluxes to aid in the removal of gases, oxides, or other impurities. The dross formed during this operation is continually removed by skimming from the surface of the melt. Since the dross so formed may contain appreciable quantities of entrained aluminum metal, it is the usual practice to further process the

dross to recover the metal. The performance of a venturi type scrubber in controlling acidic fume from dross reprocessing operations was examined by determining the collection efficiency for various compounds in the vapor and solid phase. Acid gases were completely removed provided the scrubbing liquor was maintained with an alkalinity above pH 10. Reduction in total chlorides ranging from 67-70% was achieved and a corresponding reduction in fluoride emissions was obtained; the collection efficiency was 70-87%. It was not practicable to sample the inlet gases isokinetically and only the emissions rate for total solids was determined. The unit has been in operation for almost two years and severe corrosion has occurred which no doubt has contributed to reduced overall efficiency. Construction materials evidently play an important part in the design of liquid scrubbers to control this type of fume. (Author conclusions modified)

41569

Ussar, Max B.

PROTECTION OF THE ENVIRONMENT: PROBLEMS AND TENTATIVE SOLUTIONS. (Umweltschutz-Probleme und Loesungsversuche). Text in German. Glueckauf (Essen), 1971-1972: 4-6.

General problems of environmental protection in Austria are outlined with special regard to air and water pollution. Traffic and industry account for 40% and 35% of the total emissions, respectively. The separation techniques developed for solid as well as toxic and irritant pollutants such as sulfur dioxide, chlorine, fluorine and their compounds, as well as nitrogen oxides require further improvements technically and economically. The complex nature of ecologic problems calls for the cooperation of experts and institutions in many areas. Environmental aspects of industrial processes should be made part of the curriculum of institutions of higher education. Industry should be allowed time to adopt air pollution standards.

41839

Pulley, H. and R. L. Harris

DISPOSAL OF FLUORINE AT LOW CONCENTRATIONS. Union Carbide Corp., Paducah, Ky., Paducah Gaseous Diffusion plant, Atomic Energy Commission contract W-7405-eng-26, Rept. KY-638, 12p., April 15, 1972. 3 refs. NTIS: KY-638

Experimental work has been conducted to verify the safety of fluorine disposal by means of reaction with carbon and to investigate the efficiency of the process at low fluorine concentrations. The explosive reaction occasionally observed by other workers could be eliminated by the use of low surface area amorphous charcoal. Fluorine concentrations from 0.1 to 10% could be readily reduced to less than 50 ppm by reaction with heated charcoal to produce primarily gaseous nontoxic fluorocarbons. The process appears to provide a safe, efficient, and economical method for the disposal of waste fluorine.

41932

Ennan, A. A., V. A. Anikeyev, L. P. Berezina, A. G. Firsov, A. N. Chobotarev, and V. M. Kats

HYDROGEN FLUORIDE EXTRACTION BY MEANS OF AN ALPHA-NAPHTHYLAMINE BENZENE SOLUTION. (Ekstraktsiya ftoristogo vodoroda benzolnym rastvorom alpha-naftilamina). Text in Russian. Zh. Prikl. Khim., 45(4):854-857, 1972. 14 refs.

In search for new means of hydrogen fluoride emission control, interactions between concentrated or diluted HF water solutions and alpha-naphthylamine benzene solutions as affected by the concentration of the amine were studied. Included are HF partition data between water and the organic phase utilizing 0.1 and 0.5 mole/l alpha-naphthylamine in benzene. Increasing HF concentrations in water enhanced its extraction by the organic phase. Higher concentrations of the amine increased the extraction power of the organic phase with the formation of an alpha- naphthylamine monofluorohydrate. Utilization of 0.5 mole alpha-naphthylamine/l benzene solutions led to the formation of a solid difluorohydrate derivative reaching 93.4% HF extraction yields for a 36.3% HF water solution concentration. Recovery of the extracted HF was made by treatment of the fluorohydrate with saturated sodium fluoride solutions. Utilization of alpha-naphthylamine for the extraction of HF from water solutions was feasible for the above purpose.

42078

Fischer, Friedrich and Karl-Heinz Pfefferle

WASTE GAS CLEANING PROCEDURES. (Verfahren zur Abluftreinigung). Text in German. Chem. Tech. (Berlin), 1(5):215-219, 1972. 6 refs.

Pollutants from industrial gaseous effluents can be removed by adsorption, thermal combustion, catalytic combustion, absorption, or by a combination of two of these methods. Adsorption with activated carbon is applied when the recovery of organic vapors is desired which would otherwise create a malodorous and harmful work environment. The contaminated effluents are drawn by suction produced by blowers through a layer of the adsorbent which is, after saturation, regenerated by steam. The recovered solvent- steam mix is condensed and distilled. Fully automatic equipment in a number of modifications is now available. Per ton of recovered solvent, 0.5 kg activated carbon, 100 kWh energy, 2.5 tons steam, and 30-50 cu m cooling water is required. Where recovery is not feasible because of low concentration or a multicomponent mix, thermal or catalytic combustion is more economical. Combustion of halogen, sulfur, or nitrogen compounds, which would make catalytic combustion impossible, is accomplished between 650 and 850 C. The heat required is supplied by combustion of consumer gas; the cost of operation of such an installation is approximately $18/hr. Catalytic combustion can be applied when nothing but carbon dioxide and water result. The process works with temperatures between 250 and 500 C, depending on the catalyst used; the hourly operational cost of such an installation is approximately $8.00. In the case of water-soluble solvents, recovery can be achieved by absorption such as in the recovery of acetone and dimethylformamide which are scrubbed with water and subsequently distilled, or in the recovery of hydrogen fluoride which is scrubbed by a solution of potassium hydroxide and converted to calcium fluoride. Sometimes, two or more processes must be combined, such as in the recovery of carbon disulfide and the simultaneous elimination of hydrogen sulfide from gaseous effluents in the manufacture of viscose, where the first step is accomplished by adsorption, the second by scrubbing with an alkaline solution, and subsequent oxidation to elementary sulfur.

42083

Daiichi Industries, Ltd. (Japan)

CLEAN AIR. THE PRESENT DAMAGES BY SULFUR DIOXIDE GAS AND AIR PURIFICATION DEVICE BY ALKALINE FILTER MATERIAL. (Ea kurin. Aryusan gasu ni yoru shogai no jittai to arukari rozai ni yoru kuki seijo sochi). Text in Japanese. 19p., Sept. 1, 1970.

The development of a new air-purification device (Air Clean) is described together with the results of experimental field tests. Preliminary experiment was carried out using unwoven cloth, 10 mm thick and treated with alkali, for the adsorption of eight JIS test particulates at concentrations of 20 ppm and at surface wind velocity of 0.2 m/s. Conductivity measurements showed that sulfur dioxide collection efficiency was almost constant at gas concentrations from near zero to 100 ppm. At higher wind velocity, the efficiency decreased. At 45% relative humidity (RH) or higher, the efficiency remained constant; it decreased significantly at RH 30%. The filtering material had a germicidal effect on bacillus coli and staphylococcus. Device Air Clean P was tested for adsorption of SO2 and other harmful gases. The SO2 collection efficiency was plotted against the filter life and the curve was used to estimate the life of the filter. The collection efficiency reached 99% over a certain period of time, then started to decline. Collection efficiencies for other gases were 56% for nitrogen dioxide at wind velocity 0.3 m/s and RH 80%; 52% for carbon dioxide at wind velocity 0.5 m/s; 40% for carbon monoxide at wind velocity 0.2 m/s; and 85% for hydrogen fluoride at 0.5 m/s. Particulate collection efficiency was 45 to 67%. Extended field tests in Nagasaki confirmed the efficiency of the filter. Air Clean models A and F are graphically illustrated.

42104

Schmid, Otto

A NEW TYPE OF SCRUBBER AND WET DUST COLLECTOR DESIGNED FOR THE CHEMICAL INDUSTRY. (Ein neuartiger Gaswaescher und Nassentstauber fuer die chemische Industrie). Text in German. Chem. Technik. (Berlin), 1(5):227-229, 1972.

The high efficiency scrubber and wet dust collector designed for the separation of solid and liquid particles and of noxious gases and vapors atomizes the washing liquid without the use of jets so that water and viscous liquids can be used for scrubbing. The equipment consists of a compact cylinder enclosing a preliminary filter for coarse particles, a washing zone for fine dust, a drip catcher for dust-laden droplets, and an exhaust fan; a detached settling tank is advantageous. The gas enters the cylinder tangentially above the conical bottom where coarse particles are separated by centrifugal force on the inside wall which is washed continuously by the washing liquid. Atomization of the washing liquid is accomplished by an electrically propelled, rotating, vertical atomizing wheel. The special construction of the wheel disperses the fog formed all the way to the cylinder walls, leaving no gaps. The gas passes through the fog zone at a moderate speed to achieve intimate contact with the washing liquid. The dust- laden droplets are thrust by centrifugal force against the cylinder wall, flow down, and leave the cylinder through a discharge neck in its conical bottom. The purified gas is drawn through a suction tube by suction produced by a fan situated in the upper part of the cylinder and discharged. A pump provides for the circulation of the washing liquid between the settling tank and the scrubber. The contact-time between gas and washing liquid is 20 times longer than in the venturi scrubber and hydrochloric acid, hydrofluoric acid, sulfur dioxide, and odors can, therefore, be removed simultaneously from waste gases. To increase the effectiveness of the scrubber, several atomizing wheels can be installed coaxially within the cylinder without substantial loss of gas pressure due to its flow velocity. The danger of dust explosion within the open scrubber is lessened in comparison with closed system scrubbers, but a safety valve is provided. Pressure loss is 85 to 100 mm H2O.

42172

Eickelpasch, Dieter, Helmut Kahnwald, and Herbert Tichy

EFFECT OF THE OPERATION PRACTICE ON THE EMISSION OF POLLUTING AGENTS AND CONCLUSIONS FOR THE REDUCTION. (Der Einfluss des Prozesgeschehens auf Emissionen und Folgerungen zu deren Verminderung). Text in German. Stahl Eisen (Duesseldorf), 92(12):575-581, June 1972. 8 refs. (Presented at the Eisenhuettentag, Duesseldorf, West Germany, Nov. 4, 1971.)

The close relationship between the raw material, the process conduction, and emission problems is shown by means of three examples. The gaseous fluorine compounds liberated at the sintering process can be converted to harmless calcium fluoride by the calcium oxide present in the sinter burden or that which is added to the process gas. A collection of the gaseous fluorine compounds emitted by the sintering stations with high quantities of waste gas is not yet technically feasible. The method of conversion of gaseous fluorine compounds with calcium oxide will not work if acid sinter must be produced. The quantity of brown smoke produced by steel production depends on the type of oxygen supply and on the decarbonization speed. It can be influenced to some extent at bottom-blown converters by division of the oxygen flow. The major part of brown smoke, however, can only be removed by high-efficiency dust collectors with a collection efficiency of more than 98.5% at arc furnaces and of more than 99.8% at converters. The development of nitric oxide in industrial furnaces depends on the amount of nitrogen chemically bound in the fuel, on the heating and cooling speed of the flue gases, the absolute height of the temperature, and the amount of excess air at the combustion. A reduction of the air surplus reduces the NO development. However, the combustion is not complete, which leads to the emission of carbon monoxide, smoke, and unburned matter. Through a return of 20% of the flue gas to the combustion chamber, a 60% reduction of the NO development was achieved. Injection of water or water vapor also reduces NO formation, but the capacity may be impaired and corrosive processes triggered. The NO formation can be entirely avoided by a two-step combustion or by the arrangement of several burners in the combustion chamber.

42287

Bamag Verfahrenstechnik G.m.b.H. Butzbach (West Germany)

REMOVAL OF FLUORINE FROM WASTE GASES. (Entfernen von Fluor aus Abgasen). Text in German. Umwelt (Duesseldorf), 2(3):62-64, June-July 1972. 4 refs.

Aluminum plants emit waste gases containing at times 150/mg/cu m elemental fluorine or fluorine compounds. For each ton of crude aluminum produced, the plants emit 4 kg or more of fluorine. The waste gases of superphosphate plants contain volumetric concentrations between 0.5 and 1.0% silicon tetrafluoride according to some sources even up to 3% gaseous fluorine components. The design and operation of a waste air cleaning plant for a test stand for rocket engines is described. The waste air enters the cleaning system below the packed layer of a scrubber and passes countercurrent to the scrubbing fluid, an aqueous solution of potassium hydroxide. For removal of the droplets of scrubbing fluid which are carried along by the air another packed layer is arranged ahead of the exit to the stack. The scrubbing fluid enriched with fluorine is recovered, the sludge which accumulates at the recovery is subjected to special treatment for conversion of the fluorine compounds into harmless calcium fluoride. After this treatment it can be dumped.

42458

Lobos, J. S., J. P. McGeer, and D. P. Sanderson

REACTIVITY OF ALUMINA TOWARDS HYDROGEN FLUORIDE. Preprint, American Inst of Mining, Metallurgical, and Petroleum Engineers (AIME), New York, N. Y., 10p., 1971. 2 refs. (Presented at the American Inst. of Mining, Metallurgical and Petroleum Engineers, Annual Meeting, New York, Feb. 26-March 4, 1971.)

A simple method was developed to measure reactivity of alumina toward hydrogen fluoride. The apparatus consisted of a heated alumina desiccator. A platinum dish containing a known volume of HF solution was placed in the lower compartment and the desiccator was allowed to heat to a desired temperature. Weighed samples of the alumina in 40 ml platinum crucibles were then placed in the upper compartment. After a known length of time the samples were removed, put in an ordinary desiccator and after cooling analyzed for fluoride. Alpha-type alumina was about 10 times less reactive than the gamma-type. In plant tests using various dry scrubbing systems for pot gases, the gamma-type alumina absorbed over 2% fluorine in a fraction of a second. Other relationships between absorption of fluorine and alumina properties such as degree of calcination and reactivity towards water were investigated. Preliminary operation of a two-stage cell gas scrubbing system with a cyclone incorporated demonstrated flexibility and a number of other benefits, including segregation of impurities such as iron and phosphorus and economic tar fume handling.

42991

Reiter, N. F. and A. J. Saraceno

EVALUATION AND CONTROL OF SELECTED AIR POLLUTANTS -- A LITERATURE SURVEY. Goodyear Atomic Corp., Piketon, Ohio, Chemistry Dept., Atomic Energy Commission Contract AT-(33-2)-1, 13p., Dec. 30, 1971. 102 refs. NTIS: GAT-672

The current literature pertaining to the evaluation and control of fluorine and fluorides, sulfur dioxide, nitrogen oxides, and particulates is surveyed. The majority of the 102 references cited have been published in the last 5 years. Recovery, removal, sampling, and analytical techniques for the various air pollutants are pertinent topics discussed in the cited references. (Author abstract modified)

43108

Goergen, Robert

AIR POLLUTION CONTROL IN IRON METALLURGY - FUTURE TRENDS. (Kontrolle der Luftverschmutzung in der Eisen- und Stahlindustrie - Entwicklungstendenzen). Text in German. Int. Air Pollut. Control Noise Abatement Exhib. Conf. (Proc.), Jonkoping, Sweden, 1971, p. 6:1-6:11. 6 refs. (Sept. 1-6.)

Air pollution control and related future trends in the iron metallurgy of West Germany are described. Emissions (dust, sulfur dioxide, fluorine, and other pollutants) from metallurgical plants cause nuisances of a temporary and local nature. Fine dust, SO2, and fluorine are emitted by agglomerating plants, very fine dust of 0.01-0.1 micron (brown smoke) by steel mills, and SO2 by rolling mills. The heavy fuel oil used contains 1.6% sulfur and a maximum of 10 ppm fluorine. Dust emissions from blast furnaces are controlled by electrostatic filters or wet dust separators, securing a maximum dust concentration of 3-5 mg/N cu m. Electrostatic filters and wet-type separators provide satisfactory dust separation for brown smoke. Electrostatic filters, wet processes, and particularly tissue filters are used for electric-arc and ultra-high-power furnaces. The SO2 emissions from open-hearth furnaces have decreased considerably due to the increased use of low-sulfur fuel oil or natural gas. As a result of the installation of modern pollution control devices, the shutdown of obsolete plants, and other control measures, the 1969-1970 pollution level was one tenth the 1956-level. The volume of dust sedimented over the Ruhr area decreased from 312,000 tons in 1963-1964 to 250,000 tons in 1967-1968, while the SO2 concentration decreased by 40% from 1963-1969. Authorization is required for the alteration of existing plants and the construction on new ones. While both the Thomas and Siemens-Martin processes show a downward trend, the proportion of converter steel increases. A three-stage steel manufacturing process, including agglomeration, direct reduction with sulfur-free gas, and electric melting without overheating, is being developed.

43299

Iversen, Reid E.

AIR POLLUTION CONTROL: ENGINEERING AND COST STUDY OF THE PRIMARY ALUMINUM INDUSTRY. Preprint, American Inst. of Mining, Metallurgical and Petroleum Engineers, New York, Metallurgical Society, 22p., 1972. 3 refs. (Presented at the American Institute of Mining, Metallurgical and Petroleum Engineers, Metallurgical Society, San Francisco, Calif., Feb. 22, 1972.)

Gaseous and particulate Fluorides are the most serious pollutants emitted from aluminum reduction plants. Other pollutants such as cryolite, aluminum fluoride, calcium fluoride, chiolite, hydrocarbons, and carbon have been identified. The gaseous emissions, in addition to the fluorides, have been identified as carbon monoxide, carbon dioxide, sulfur dioxide, nitrogen oxides, hydrogen sulfide, carbonyl sulfide, carbon disulfide, silicon tetrafluoride, and hydrogen fluoride. The greatest source of pollutants of all types is normally at the individual electric cells or pot lines. The anode bake plant is potentially the second greatest source. Emissions from an uncontrolled prebake potline have been measured at 92 lb/t Al, total solids, 60 lb/t SO2, and 46 lb/t total F as well as volatilized hydrocarbons. Primary controls collect emissions at the pot head; secondary controls are located in the roof monitor area. About 75% of the plants in the U. S. have primary controls only, 7% have primary and secondary, 15% have secondary controls only, and 3% have no controls. The industry as a whole showed an emission control factor for total F of 73%. This amounts to 12 lb gaseous/t of Al and 19 lb/t for solids. A well designed pre-bake plant with primary and secondary controls could reduce emissions to 1.6 lb/t gaseous and 5 lb/t solids. Annual costs to the industry for control devices are now $58/T for capital and $16/T for operating expenses. Control systems include baffles, spray towers, wet cyclones, packed towers, bubbler towers, venturi scrubbers, mechanical collectors, multicyclones, electrostatic precipitators, bag filters, absorption, and fluidized beds.

43481

Chapman, Frank E., Jr.

ATTAINMENTS IN REDUCING AIR POLLUTION. Preprint, 9p., 1971. 5 refs. (Presented at the National Plant Engineering and Maintenance Conference, 23rd, Philadelphia, Pa., Jan. 24-27, 1972.)

The Pemco plant manufactures frits (special glasses used in porcelain enamels and ceramic glazes) and produces from 600 to 700 different formulation each year. To meet emissions requirements, the plant was requested to eliminate an opaque white plume issuing from one of the smelters and to eliminate

fluoride-bearing compounds emitted from the stack. Because fluorine was present in the stack emissions, a wet control system was necessitated. Letters were sent to 21 companies requesting a firm quote on venturi-type scrubbers, each system to consist of five separate gas-cleaning systems. Only one gas- scrubbing device consisting of a quench unit, a venturi scrubber, and a separator unit is to be initially installed in order to determine the following: the need for debugging of the air pollution control equipment; the effect on visible plume; the effect on particulate emissions; the effect on lead, fluoride, and nitrogen oxide emission; the effect on water pollution; the effect on water economics; the proper sizing of the pressure drop in the venturi throat; and possible methods of increasing the number of smelters per system. A synopsis of a computer model study of the plant pollution run by the Baltimore Systems Department is presented.

43533

Pettit, A. B.

CONTROLLING FLUORIDE EMISSIONS FROM ACIDULATION OF PHOSPHATE ROCK. Air pollution and Smoke Prevention Assoc. of America, Proc. Air Pollution Smoke Prevention Assoc., Annu. Conv., 44th, Roanoke, Va., 1951, p. 98-104.

Superphosphate, used to fertilize soils which are deficient in phosphorus, is produced from phosphate rock treated with sulfuric acid in an operation known as acidulation. Analysis of 72.0-72.5% B.P.L. Florida pebble phosphate rock shows a fluoride content of 3.6%. When the rock is acidulated, in normal practice, approximately 32% of the fluorine is released. Construction specifications, operating and maintenance problems, water requirements, and apparent efficiency are described for three emission control techniques: water-spray scrubbing towers, the Schutte and Koerting fume scrubber, and a water-spray horizontal scrubber. The apparent efficiencies are 95%, 98+%, and 99+%, respectively. The efficiency data were obtained by analyzing the rock going to the mixer and the superphosphate as it left the elevator and then calculating the fluorine evolved. Stack exit gases were sampled and analyzed for fluorides, and the total emissions to the atmosphere were calculated. The efficiency was based upon the relative amounts evolved and emitted.

43840

Hemming, Charles

WHAT INDUSTRY IS DOING ABOUT POLLUTION CONTROL. Civil Eng. (N. Y.), 41(9):59-62, Sept. 1971.

Developments in air and water pollution control by five major industries are reviewed. Hercules, Inc. is constructing an advanced solid-waste reclamation plant in Delaware that will convert 500 tons of refuse and 70 tons of sewage sludge/day into marketable products. Dow Chemical Company has a number of projects underway at its Midland, Michigan, Division, including brine purification, the installation of detection devices on sewers, and environmental monitoring in the form of a specially designed van which tours potential trouble areas around the plant. Alcoa has perfected a system for recycling fluoride effluents in smelting operations. The fumes given off in a aluminum smelting, heavy with particulate and gaseous fluorides, are ducted through a bed of alumina which chemisorbs the gaseous fluoride. Particulate fluoride is captured in filter bags. Recovered fluorides are recycled to potline cells where they contribute to the continuous smelting process. The Alcoa 398 Process is more than 99% efficient in recovering potential pollutants. General Motors is active in planning abandoned-car cleanup campaigns. Allied Chemical Corporation has developed a pipeline-charging system that controls air pollution resulting from coke ovens by reducing smoke and gases from by-products by as much as 70%.

43863

Jackson, Jesse, Jr.

TOTAL UTILIZATION OF FLY ASH. Bureau of Mines, Washington, D. C. and IIT Research Inst., Chicago, Ill., Proc. Mineral Waste Utilization Symp., 3rd, Chicago, Ill., 1972, p. 85-93. 9 refs. (March 14-16.)

Progress was made in demonstrating the feasibility of a proposed flowsheet for the total utilization of a powerplant-generated fly ash. The flowsheet takes advantage of the existing commercial Enercon-Stirling process for production of low-cost iron oxide, carbon, pozzolan, and lightweight aggregate, and expands it by diverting beneficiated nonmagnetic fly ash or pozzolan streams into alumina, regulated-set, and portland cement production. Greater than 90% alumina was recovered from fly ash by either the lime- soda-sinter-leach technique or the lime-sinter-leach technique. Good quality regulated-set and portland cements were made by clinkering a mixture of recovered alumina, limestone, beneficiated fly ash, and the calcium silicate residues from the lime-sinter alumina recovery process. Preliminary results are also presented from studies directed toward expanding the proposed flowsheet to encompass waste silico-fluorides from superphosphate fertilizer production. Recommendations for future research are made. (Author conclusions modified)

43972

Blake, Henry E. and W. A. Stickney

UTILIZATION OF BY-PRODUCT FLUOSILICIC ACID. Bureau of Mines, Washington, D. C., and IIT Research Inst., Chicago, Ill., Proc. Miner. Waste Util Symp., 3rd, Chicago, Ill., 1972, p. 179-183. (Ma 14-16.)

Two processes are described for utilizing the waste fluosilicic acid (H2SiF6) generated by the processing of phosphate-rock into fertilizers. The first process involves conversion of fluosilicic acid to a synthetic acid-grade fluorspar (CaF2) by first precipitating the silica with ammonia and filtering, and then reacting the ammonium fluoride (NH4F) filtrate with hydrated lime (Ca(OH)2). By this method over 95% of the fluoride is converted to calcium fluoride (CaF2). The second process involves neutralizing the H2SiF6 with Ca(OH)2 and silica and filtering and then volatilizing hydrofluoric acid (HF) from the dry precipitate by pyrohydrolysis at 1050 C. The HF-H2O vapors are condensed and the fluoride precipitated as sodium bifluoride (NaHF2) by addition of sodium fluoride (NaF) to saturation. Anhydrous HF is recovered from the dried NaHF2 by pyrolysis at 400 C. By this method, over 80% of the fluoride in H2SiF6 is recovered as anhydrous HF. (Author abstract)

44121

Schmidt, Ernst

REDUCTION OF AIR-POLLUTANT FLUORIDE EMISSIONS BY MEANS OF PULVERIZED HYDRATE OF LIME. (Verminderung luftverunreinigender Fluor-Emissionen durch Kalkhydrat-Pulver). Text in German. Ziegelind. (Weisbaden), 25(3):1-16, 1972. 16 refs.

A study was conducted with the aim of reducing the emission of gaseous air pollutants, mainly fluoride compounds, from the raw material in the course of brick firing. The method tested is based on the dry injection of pulverized lime hydrate. The primary objective was to reduce the sulfur oxides concentration,

since this had been shown to influence the fluoride emission during firing. The pulverized lime hydrate was injected directly into the kiln. It was found that with a suitable feed, proportioning, and distribution a considerable linkage of the sulfur components may be achieved and also an indirect reduction of the fluoride emissions. The disadvantage of direct feeding into the kiln is that the powder comes in contact with the brick setting. Therefore, the process cannot be used for sintering goods. Considerable drawbacks also arise where large quantities of powder are required. The injection of powder into the smoke flue was tested. Observations of performance showed that, in addition to almost complete chemical linkage of sulfuric acid, favorable results were obtained with fluoride under certain specific conditions. The essential preconditions for this were reaction areas of adequate size, i.e., smoke flues of sufficient length and correct proportions. In the first plant installation with powder feed of one-third into the kiln and two-thirds into the smoke flue, a fluoride emission was down from about 70 mg/cu m to 2.3 mg/cu m. With feed into the smoke flue alone, a reduction of 90% was obtained. These results indicate that the process may be applicable to many brickworks as a means of avoiding damage or of enabling lower chimney stacks to be used.

44343

Waki, Koichi

ALUMINUM REFINERIES. (Aruminyumu seirenjo). Text in Japanese. (Kinzoku Zairyo (Metals in Engineering), 12(5):45-51, May 1972. 19 refs.

Pollution at aluminum refineries and its control is discussed. The major material for the production of aluminum by the electrolytic method is cryolite to which aluminum triflucride is usually added to increase the current efficiency, decrease the melting point, and protect the electrolyzer. The addition results in the formation of sodium aluminum tetrafluoride, which is volatile and reacts readily with water vapor to form hydrogen fluoride. The amount of fluoride discharged depends largely on the residue hydrocarbon on the anode, the alumina in electrolyzer, and the temperature and bath ratio. A combination of dust collector, such as a cyclone or an electrostatic precipitator, for the removel of particulates, and a washing tower for the removal of HF gas is used for the purification of flue gas from Al refineries.

44638

Francis, Fred J.

SECONDARY ALUMINUM SMELTER AIR POLLUTION CONTROL USING A CHROMATOGRAPHIC COATED BAGHOUSE -- A TECHNICALLY NEW AND ECONOMIC SOLUTION. Preprint, Air Pollution Control Assoc., Pittsburgh, Pa., 25p., 1972. (Presented at the Air Pollution Control Association, Annual Meeting, 65th, Miami, Fla., June 18-22, 1972, Paper 72-79.)

The sources of air pollution for secondary aluminum smelters and chromatographic coated baghouses to control that pollution are described. The secondary aluminum smelting industry consumes aluminum scrap generated by wastage from new factory production or from obsolescence and scrapping of old products. This industry represents approximately 25% of total production of aluminum in the United States. The raw material is scrap, and it comes with pollutants, such as: oil, paint, and plastics, and because of its volume it has to be melted under a flux cover containing salt, potash, cryolite, or fluorspar, which gives off fumes containing chlorides and fluorides. In addition, most of the scrap intake into a smelter consists of wrought alloys containing magnesium (e.g., beer cans). The pollutants in aluminum industry are: carbonaceous particles both combustible and noncombustible, oil particulates, magnesium and aluminum chlorides, chlorine, hydrogen chloride, and hydrogen fluoride. Control methods attempted throughout the world, namely scrubbers, afterburners, and baghouses are reviewed briefly. The reasons for choosing the novel chromatographic coated baghouses are explained. Results of tests from a total of four runs completed utilizing chromatographic coated baghouses are discussed. Samples taken for dust analysis reveal that in all four runs, the amount of emitted dust was down to the minimum (an average of 0.0005 grain). The results of runs show it is possible to reduce particulate emission and noxious emissions to virtually zero by means of chromatographic coated baghouses. An analysis is made of operating costs, which are 1/3 to 1/2 of other potential systems, such as scrubbers and afterburners. (Author abstract modified)

44716

Kauffmann, Heinz and Dieter Kreuch

WASTE INCINERATOR AT THE HEIDENHEIM COMPOSTING PLANT. (Die Resteverbrennungsanlage des Kompostwerkes Heidenheim). Text in German. Muell Abfall, 2(3):76-83, 1970.

The waste incinerator of the composting plant at Heidenheim, West Germany is described. The incinerator, designed to handle a total of 12,000 tons of domestic and industrial wastes yearly, has a throughput of 500-2000 kg/hr at an average calorific value of 3000 kcal/kg. The wastes contain relatively large proportions of polystyrol and polyurethane with hydrochloric and hydrofluoric acids in the waste gas as a result. A high combustion chamber was built to provide optimum thermodynamic conditions. The waste gases, discharged at a rate of 25,000 N cu m/hr at 140 C, are purified after passing through a two-stage heat exchanger in a venturi scrubber using water with a lime milk additive. Effective dust separation is reached, and some 44% of the sulfur dioxide and HCl and HF are absorbed. The pressure loss lies at 260 mm water column. The purified gases are heated before discharge to avoid fog formation. Oil residues are burnt by means of gasification burners, and an auxiliary combustion chamber, equipped with oil burners, is provided for the incineration of slaughterhouse wastes.

44793

O Connor, G. V.

THE CHEMICAL INDUSTRY S ASSISTANCE TO ANOTHER INDUSTRY IN ABATING POLLUTION. Air Pollution Control Assoc., Pittsburgh, Pa., Proc. Air Pollution Control Assoc., Annu. Meet., 49th, Buffalo, N. Y., 1956, p. 32/1-32/6. (May 20-24.)

A number of successful air pollution abatement programs established by the chemical industry are discussed. One of these is the recovery of sulfur dioxide from the waste gases of sulfide ore refineries. Sulfuric acid is manufactured from this by-product SO2 and is used in the manufacture of fertilizer from low grade phosphate rock. Thus, the threat of SO2 as a hazard to vegetation, animals, and humans is removed and at the same time a useful and economically profitable product is made. The chemical industry has also developed a process for converting the hydrogen sulfide in natural gas to elemental sulfur. The problem of carbon black waste has been solved by installing triplicate and quadruplicate collection systems, which insure 100% carbon black recovery. Fluorine is one of the pollutants emitted by the fertilizer industry. A process was devised where additional silica is added to the phosphate rock digestion system, producing hydrofluosilicic acid. This is scrubbed with a dilute caustic soda solution forming soldium

fluosilicate, which is used for the fluoridation of municipal water supplies. In the coking of coal, the gas produced has traditionally been scrubbed with H2SO4 to remove ammonia and produce ammonium sulfate. However, the value of ammonium sulfate has fallen so that it is no longer economical to recover it. If ammonia is not removed from coke oven gases, it will be released to the atmosphere. A process in which phosphoric acid is substituted for H2SO4 is described in detail. The economic advantages of this process are also discussed.

44838

Rush, Dumont, John C. Russell, and Reid E. Iversen

EFFECTIVENESS AND COST OF AIR POLLUTION ABATEMENT ON PRIMARY ALUMINUM POTLINES. Preprint, Air Pollution Control Assoc., Pittsburgh, Pa., 23p., 1972. (Presented at the Air Pollution Control Association, Annual Meeting, 65th, Miami, Fla., June 18-22, 1972, Paper 72-78.)

Effluent data from aluminum potlines permits the construction of models of smelter effluents, representative of present practice in the United States, which may be acted upon in accordance with various demonstrated collection and removal efficiencies of control systems and their costs in order to evaluate the cost-effectiveness of various control schemes and to estimate the costs involved in upgrading pollution abatement in the industry. Representative capital and operating costs and removal efficiencies for a number of kinds of applicable control equipment have been developed and organized in a way which permits approximate evaluations among alternative approaches to pollution abatement. The application of the best demonstrated pollution abatement technology to the collected primary effluents from aluminum potlines would result in representative total fluoride emissions of from 1.2 to 4.7 lbs/1000 lbs of aluminum produced depending on the type of potline. The addition of scrubbing equipment on the secondary or building ventilation streams would reduce total fluoride emissions to the range of 0.8 to 2 lbs/1000 lbs aluminum, at considerably increased costs. A systems analysis was applied to the entire United States aluminum production industry showing the expected costs and performance parameters associated with upgrading the industry control from the present 74% to four higher levels of control. This analysis indicates that the application of best demonstrated control technology to the entire industry would raise overall control efficiency from 74 to 92%; it would increase invested industry capital for pollution control from $51 to $175/ton capacity, and would raise the industry operating cost of pollution abatement from $13 to $43/ton of aluminum produced at capacity. Pollutants from aluminum smelters include fluoride, hydrogen fluoride, alumina, particulates, and sulfur oxides. Control equipment includes scrubbers, electrostatic precipitators, cyclones, venturi scrubbers, and lime desulfurization.

44979

Brandt, Alleu D. and David M. Anderson

THE CONTROL OF INDUSTRIAL AIR POLLUTION SOURCES. Dept. of Commerce, Washington, D. C., Bureau of International Commerce, Environ. Control Sem. Proc., Rotterdam, Warsaw, Bucharest, 1971, p. 199-212. 26 refs. (May 25-June 4.) NTIS: PB COM-72-50078; GPO

Efforts to control air pollution have increased in the past 2 years, a period during which profits have fallen. The total investment required to control air pollution from the major process industries between 1970 and 1976 is approximately $3,900,000. Particulate matter is the major pollutant released from most industrial processes, and includes fumes, mists, and smoke. Gaseous pollutants, such as sulfur dioxide, hydrocarbons, fluorides, and carbon monoxide are problems for a few specific industries. Controlling a point source is purely a problem in gas or air treatment, while control of a mobile source is much more evasive because technology is frequently not available. Control of particulate emissions may be achieved through process changes and operational changes, or through particulate removal equipment. Treatment facilities include centrifugal separators, fabric filters, scrubbers, and electrostatic precipitators. It is expected that by 1980 the emission rate from industrial air pollution sources in the United States will be reduced by at least 90% from 1967 levels. Industrial sources include mineral processing, kraft pulping petroleum refineries, metallurgy, fertilizer manufacturing, and rubber manufacturing. Other sources are transportation, electric generation, forest fires, and solid waste disposal.

45004

Richter, Frank

POLLUTION CONTROL EQUIPMENT PAYS OFF IN TWO YEARS. Air Eng., vol. 2:27-29, 53, July 1960.

New pollution control equipment installed at the Virginia-Carolina Chemical Corporation plant, Memphis, Tennessee, is described. Two plant processes caused air pollution: the acidulation of ground phosphate rock dust with sulfuric acid, and the chemical mixing of dry phosphates and potash with liquid nitrogen. To solve the first problem, an injector-type gas scrubber (80% efficiency), which allowed the discharge of noxious substances to the atmosphere, was replaced with a low-velocity cell-type wet scrubber designed to absorb the fluorine and precipitate the solid silica fluoride flakes with 99% efficiency. The unit consists of five stave tubes in series, with two 12-in. baffles in each tube, and with a 6000 cub ft/m induced draft paddle impeller fan at the discharge end, 30-ft stack, and a 15-ft by 21-ft by 12-in. deep concrete pan, lined with acid-proof brick. There are 13 sprays in the five tubes using 190 g/hr each. Fluorine in the discharged gas stream is reduced to 8 ppm. Silica fluoride as a solid is precipitated 100% to condenser pan. The installation will not pay for itself, but it is a necessity to continue operating in Memphis. The second problem was solved by installing multiple tube collectors on the exhaust side of the fans. A 177 tube collector on the dryer has a 18,000 cu ft/m capacity at 5.1 in. water-gage pressure drop and 125 F. A 120 tube collector has a 12,000 cu ft/m in capacity at 5.1 in. water-gage pressure drop and 125 F. The breeching, flues, cyclone and collectors were insulated. The 25 hp fan motors were replaced by 40 hp motors, and the speeds of fans were increased. The installed collectors collect 100% of all 14-micron dust and larger. It is estimated that this installation will repay the capital cost in 2 years from the value of materials recovered. Total cost of the air pollution control equipment was $62,000. Intangible savings were improved formulation; greater production efficiency; improved working conditions; and better public relations due to elimination of annoying dust in the neighborhood.

45078

Robinson, J. M., G. I. Gruber, W. D. Lusk, and M. J. Santy

ENGINEERING AND COST EFFECTIVENESS STUDY OF FLUORIDE EMISSIONS CONTROL. (FINAL REPORT). VOLUME II. Resources Research, Inc., McLean, Va. and TRW Systems Group, McLean, Va., Office of Air Programs Contract EHSD 71-14, APTD 0944, 171p., Jan. 1972. 1026 refs. NTIS: PB 209647

The appendix and bibliography of a report on the costs of fluoride emissions control are presented. Two general types of pollution control equipment are currently used for fluoride

emissions, wet collection equipment and dry collection equipment. The majority of capture devices used for fluoride removal are of the wet type. Wet collection systems simultaneously remove gaseous and particulate pollutants. The types of wet collection equipment described include: spray towers, packed bed scrubbers, wet cyclones, self-induced spray scrubbers, orifice plate bubblers, venturi scrubbers, jet scrubbers, and dynamic wet scrubbers. Under certain conditions, dry collection systems have been applied to fluoride emissions control. Three main classes are available: mechanical collection equipment, such as settling chambers, baffle chambers, skimming chambers, louver type collectors, dry cyclones, impingement collectors, and dry dynamic collectors; electrostatic precipitation; and fabric filtration. Inventories of industrial plant locations and capacities were prepared for the industries which are known or potential sources for fluoride emissions. The industries covered include: phosphate rock processing, iron and steel production, primary aluminum smelting, coal burning, steam electric power generation, hydrogen fluoride production; clay products, glass products, enamel frits, and non-ferrous metal smelters. A bibliography containing more than 1000 references is included.

45254

WASTE GAS CLEANING SYSTEM FOR FERTILIZER PLANT. (Abgasbeseitigung bei einer Vollduengeranlage). Text in German. Wasser Luft Betrieb, 16(8):274, 1972.

Results obtained with a wet-type electrostatic separator at a fertilizer plant are described. After particulate pollutants have been separated by a preliminary stage scrubber, the waste gases, discharged at a rate of 8000 N cu m/hr at 60 C, contain 4320 mg/N cu m of ammonium nitrate, 5000 mg/N cu m of ammonia, 140 mg/N cu m of silicon tetrafluoride, and 270 mg/N cu m of nitric oxide and nitrogen dioxide (maximum values). The wet-type electrostatic filter has efficiencies of 94.2-98.9% for ammonium nitrate, 80-100% for nitric acid, and practically 100% for ammonia; and the purified waste gas is invisible. The matter separated by the electrostatic separator is recovered from the circulated water.

45380

Partsef, D. P. and I. V. Prozorovskaya

ON THE DETERMINATION OF SANITARY PROTECTION ZONES AROUND NONFERROUS METALLURGICAL PLANTS. (K voprosu ob opredelenii sanitarno-sashchitnykh zon vokrug predpriyatiy tsvetnoy metallurgii). Text in Russian. Gigiena i Sanit., 37(16):94-96, 1972.

Emissions from an electrolyte copper and an aluminum alloy manufacturing plant were measured. The three-stage process at the electrolyte copper manufacturing plant includes a shaft furnace, a converter, and an anode furnace. The shaft furnace and converter processes, at temperatures up to 1400 C, emit zinc, lead, tin, and other nonferrous oxides; carbon monoxide; and sulfur dioxide. The maximum zinc and lead contents in dust samples were 70 to 10%, respectively. Two-stage dust separation using a cyclone-bag filter combination with an over-all efficiency of 99.8% was used as a control. The aluminum alloy manufacturing plant releases generally small amounts of such pollutants as chlorine and fluorine compounds, CO, and SO2. Two- stage gas cleaning using scrubbers and venturi tubes effected an over-all efficiency of 98%. Replacing the shaft furnace with an electric-arc furnace and abandoning fluorine-base fluxes also considerably reduced the pollution.

45468

Bernatzky, Aloys

GREEN AREAS AND URBAN CLIMATE. (Gruenflaechen und Stadtklima). Text in German. Staedtehygiene (Uelzen/Hamburg), 21(6):131-135, June 1970.

Facts showing the major changes in urban climate due to air pollution and the positive effects of green areas and trees are reviewed. Dust, sulfur dioxide, hydrofluoric acid, and carbon monoxide are the most dangerous air pollutants in urban atmospheres. Some 10-20% of the total solar radiation and almost the total ultraviolet radiation are absorbed by the polluted atmosphere over cities. Increased carbon dioxide levels, causing the well-known greenhouse effect, result in elevated temperatures in cities compared to their suburbs. The temperature differences may be 0.5-1.5 C on a yearly average, and more than 10 C in absolute values. Green areas and trees, though unable to eliminate the effects of pollution, have many advantages. Dust, including radioactive substances, are filtered out by trees in considerable proportions, and decreased wind speeds, by a minimum of 10%, can be observed. Radioactivity, measured on the lee side of trees, accounted for only 25% of that measured on the weather side. Trees absorb very high amounts of CO2 and produce oxygen. Decreased temperatures in green areas are a fact. Temperatures up to 3.5 C lower over green areas, compared to adjacent areas, were measured. In addition, green areas are of great value from a psychic point of view.

45544

Descolas, Jean

THE ACTION TAKEN BY DUST SEPARATORS MANUFACTURERS. (Action des constructeurs de separateurs et epurateurs). Text in French. Pollut. Atmos. (Paris), vol. 13:48-49, May 1971.

Developments in dust separating techniques and dust separator production in France are reviewed. Economic and reliability factors should be considered when choosing between optional dust separating techniques. Dry dust collectors, venturi scrubbers for blast furnaces, bag filters, electrostatic precipitators, and gas scrubbers underwent spectacular development during the past years. Glass-fiber bag filters are able to treat gases with a maximum temperature of 315 C, with dust removal from bag filters by knocking and air counter-flow. Discharge electrodes with increased strength, electronic controls, and silicon rectifiers have been developed for electrostatic precipitators. Scrubbers are used for the removal of sulfur dioxide, fluorine, and odorous gases in the aluminum, pulp, and chemical industries. The market of dust separators projects a yearly growth of 15-20% in the near future. Exports accounted for some 20% of the total sales. The respective shares of dry cyclones, wet type dust separators, electrostatic precipitators, and bag filters are 15, 20, 35, and 25%, respectively.

45707

Mazumdar, A. H.

ENVIRONMENTAL POLLUTION III -- PETROLEUM AND CHEMICAL INDUSTRIES. Chem. Process. Eng., 5(13):30-35, March 1971. 5 refs.

Pollutant emissions and methods for pollution control in the petroleum and chemical industries are examined. Besides general problems caused by smoke, sulfur dioxide, nitrogen oxides, and fly ash, the specific pollutants emitted from processes within the fertilizer industry, acid plants, rayon manufacturing plants, carbon black manufacturing, refineries, petrochemical industry, solvent production, pesticide manufac-

turing, and pulp and paper mills include hydrogen fluoride, ammonia, fluorides, sulfuric acid mist, hydrogen chlorides, hydrogen sulfide, mercaptans, carbon disulfide, chlorinated and oxygenated hydrocarbons, polynuclear hydrocarbons, carbon soot, mercury vapors, lead burning fumes, and caustic mists. Some methods of control or counteraction include incineration or ozonation of foul fermentation odors, filters, wet scrubbing, catalytic oxidation, flares, fiber glass filter bags, absorption towers, alkaline solutions, removal techniques with by-product recovery, furnace design modifications, venturi fume scrubbers, and various process modifications.

45757

Teller, Aaron J.

CONTROL OF EMISSIONS FROM GLASS MANUFACTURE. Ceram. Bull., 51(8):637-640, Aug. 1972. 5 refs. (Presented at the American Ceramic Society, Ceramic-Metal Systems Division, Fall Meeting, St. Louis, Mo., Sept. 13, 1971, Paper 3-C-71F.)

Emissions from glass furnaces, ranging from noxious gases to submicron particulates, are unique in that they consist to a high degree of raw materials or degraded raw materials. Typical emissions from glass furnaces include particulates containing sodium fluoride, calcium fluoride, silica, calcium oxides, lead oxides, sodium sulfate, and boron oxides and gases of fluorides, nitrogen oxides, and sulfur oxides. Two systems were tested as prototypes for the control of emissions and to establish the potential for the recycle of the recovered contaminants. The wet system comprises a quench section, nucleation scrubber, and a water system consisting of a reactor-precipitator, solids separator, and cooling tower. The dry recovery system is based on simultaneous filtration and chromatographic absorption with pipeline solids injection and baghouse recovery. Both systems are characterized by low energy consumption and control emissions of particulates to the range of 0.01-0.03 grain/scf and noxious gases to the range of 1 ppm. System design, operation, efficiency, operating variables, and capital and operating costs are examined.

45846

Givaudon, Jean

ACTION IN THE CHEMICAL INDUSTRY. (Action dans industrie chimique). Text in French. Pollut. Atmos. (Paris), vol. 13:44-47, May 1971.

The efforts by the French chemical industry in the field of pollution control are outlined. Pollution control is very often combined with, or motivated by, the recovery of certain products. Scrubbing, absorption, adsorption, and oxidation are the basic means of controlling air pollution in the chemical industry. Scrubbers are used for the removal of fluorine compounds. Sulfur dioxide formed during sulfuric acid production is recovered at 90% efficiency by diluted ammonia solution. Nitrous vapors can be reduced by means of hydrocarbon in the presence of a high- temperature catalyst or by increasing the nitric acid absorption rate to 99.5-99.7%. Maleic and citraconic anhydrides formed during phthalic anhydride production are removed by means of catalyst and scrubbers, and maleic anhydride is recovered. Waste gases from the purification of natrual gas, containing small amounts of SO2 and hydrogen sulfide, but high concentration, of water vapor, are burned to form sulfur trioxide which is then converted into sulfuric acid at a rate of 90-95%. The desulfurization of waste gases from oil-fired power plants and catalysts for the afterburning of automotive exhaust are also considered.

46050

Konopka, A. P. and N. W. Frisch

THE CONTROL OF AIR POLLUTION FROM GLASS PRODUCTION -- A STATE OF THE ART REVIEW. Preprint, American Ceramics Society, Columbus, Ohio, 58p., 1971. 24 refs. (Presented at the American Ceramics Society, Annual Meeting, 73rd, Chicago, Ill., April 27, 1971.)

Techniques for the control of emissions from glass production are not well developed. On a weight basis, uncontrolled emissions from glass production are lower than uncontrolled emissions from typical major sources. Nevertheless, the trend in emissions code requirements and plume opacity criteria is to continue to heighten restrictions. Increasing concern over fine particles and hazardous pollutants also concerns the glass industry. Major sources of atmospheric emissions from glass production are glass melting and fiberglass forming. During glass melting, gases are liberated via decomposition and by the volatility phenomena. The potential gaseous emissions from soda lime glass melting include sulfur dioxide, nitric oxides, carbon monoxide, and fluorides. Particulates and opacity are considered. U.S. air pollution laws, particulate codes, and opacity and odor regulations are discussed. The impact on glass production is discussed. The uncontrolled glass furnace emissions are generally within code compliance. Except for marginal violation situations, the process modification route does not offer much promise for compliance. The nature of the submicron particulates requires sophisticated control techniques. A first-approximation estimate of 80% minumum collection efficiency, or an 0.01 gr/std cu ft stack discharge, appears reasonable to satisfy opacity criteria. In addition, fluorides and sulfur trioxide will need to be controlled or eliminated in the near future. Techniques such as high-energy scrubbing, fabric filtration, and electrostatic precipitation are far from immediate solutions to the problems. A great deal of additional study is required, and much of this is already underway.

46086

Menin, Giannantonio and Gian Berto Guarise

REMOVAL OF SILICON TETRAFLUORIDE IN PERPHOSPHATE MANUFACTURING PLANTS. (Depurazione da SiF4 in impianti per perfosfata). Text in Italian. Atti Ist. Veneto Sci. Lett. Arti Cl. Sci. Mat. Natur., vol. 128:1-14, 1969-1970. 8 refs.

The control and removal of silicon tetrafluoride from gases evolved in the manufacture of superphosphate when ground phosphate rock reacts with sulfuric acid are examined. Physico-chemical aspects of SiF4 absorption in water, the effect of silicon hydroxide on the superficial properties of the water drops, and the mist formation are considered. Silicon tetrafluoride is evolved from calcium fluoride impurities of the phosphate mineral in the presence of silicon dioxide. The formation of Si(OH)4 by absorption and reaction of SiF4 in water produces fog through change of the surface properties of water droplets. The scrubbing efficiency of industrial plants are compared. The rotating disk tower appears to be the most convenient SiF4 scrubber.

47054

Kawai, Misao

TREATMENT TECHNIQUES FOR TOXIC GASES. (Yugai gasu shori gijutsu). Text in Japanese. Kankyo Sozo (Environ. Creation), 2(10):6-20, Oct. 1972. 19 refs.

Installations that emit toxic gases and emission standards are reviewed in a table. The principle of gas absorption is

reviewed and the gas-liquid double film (interface) theory is mathematically explained. Representative absorption towers such as a turbulent contact absorber, packed tower, spray tower, cyclone scrubber, venturi scrubber, and jet scrubber are briefly mentioned. Methods for absorbing toxic gases such as fluorine, hydrogen fluoride, silica fluoride, chlorine, and hydrogen chloride are discussed. Various methods of hydrogen sulfide elimination techniques such as the phenolate process, tripotassium phosphate method, the alkazid process, the amines, the iron oxide-dry-box process, the ferrox process, the Seaboard and vacuum carbonate process, the thylox process, the Fumaks process, the Takahax process, the alkaline liquors process, and the catalytic conversion to sulfur process are explained with chemical formulas and diagrams.

47086

Shapiro, J. L. and W. L. Kuo

THE MOHAVE/NAVAJO PILOT FACILITY FOR SULFUR DIOXIDE REMOVAL. Preprint, Office of Air Programs, Research Triangle Park, N. C., Div. of Control Systems. p. 507-526, 1971. (Presented at the International Lime/Limestone Wet Scrubbing Symposium, 2nd, New Orleans, La., Nov. 8-12, 1971.)

The Mohave/Navajo Sulfur Dioxide Removal Research Program is a project for testing alkali absorption processes on a pilot-size basis. The major thrust of the work is to determine the characteristics of these processes as applied to boilers fired with low-sulfur coal. The pilot plant facility is described, including the four types of absorbers to be tested, the analysis procedures, and the test plan. Turbulent contact, venturi, polygrid packed, and Lurgi impingement absorbers are indicated. Sulfur dioxide, oxides of nitrogen, dust loading, trace metals, sulfur trioxide, and fluorine concentrations are to be tested, as well as pH, density, and liquor stream concentrations.

47095

Schmidt, Alfred

THE INDUSTRIAL USE OF THE FLUORINE CONCENTRATION OF THE RAW PHOSPHATE. (Die industrielle Nutzung des Fluor-Gehaltes der Rohphosphate). Text in German. Chem. Ing.-Tech., 44(19):1093- 1099, Oct. 1972. 10 refs.

The rapidly increasing demand of fluorine as a raw material has made the utilization of a hexafluoro-silicic acid, which is obtained at the production of phosphate fertilizer, necessary. The recovery of the hexafluoro-silicic acid from the waste gases or vapors is simple. The waste gas, cleaned by various types of scrubbers, must contain silicium tetrafluoride which liberates part of the silicic acid upon absorption in water. The separated silicic acid tends to incrustate the scrubber. For best results therefore centrifugal or venturi scrubbers are used. The recovery of the fluorine from the vapors of the phosphoric acid concentration is somewhat more difficult, since the evaporators operate with a vacuum. In this case empty scrubbers are used into which the scrubbing fluid is injected by several nozzles. In both cases a 20 to 25% hexafluoro- silicic acid solution can be obtained. The methods of production of calcium fluoride, aluminum fluoride, and cryolite, as well as hydrogen fluoride, from hexafluoro-silicic acid are described.

47125

Yoshihara, Tadashi, Toshiaki Sakurai, and Takeshi Imura

FOUNDRY OF CAST IRON, SAYAMA FACTORY, HONDA MOTOR CO. - REMARKABLE FEATURE REGARDING TO THE COUNTERMEASURES FOR PUBLIC NUISANCE. (Honda giken kogyo (kabu) sayama seisaku-sho chuzo kojo - kogai taisaku ni tokushoku). Text in Japanese. Imono (Foundry), 44(7):593-597, July 1972.

A new melting process at a cast iron foundry uses a cupola of the heating-water-cooling type with a 5 ton/hr capacity. The entire exhaust gas is treated in a recombustion furnace, then the exhaust gas goes through a heat exchanger, and is cooled again by a gas cooler to 400 C. Microparticle dusts go through a wet chamber and then are sent to an electrostatic precipitator. The final gas emission contains less than 0.05 g/cu cm of dust. The radical operation system previously used fluorite and created the problem of fluoride gas. It was replaced by an alumina base solvent specially developed by this plant. Good results are obtained.

47186

Panesko, J. Vincent

HYDROFLUORIC ACID SCRUBBER SYSTEMS. Atlantic Richfield Hanford Co., Richland, Wash., Chemical Processing Div., Atomic Energy Commission Contract AT(45-1)2130, Rept. ARH2343, UC-4, TID-4500, 11p., June 1972. 4 refs. NTIS: ARH-2343

Caustic or aluminum scrubber solutions were tested to remove hydrogen fluoride vapors from waste off-gas streams. The efficiency of the tested solutions was greater than 99%. Two potential problem areas were observed: rapid HF addition rates could increase the temperature of potassium hydroxide to near boiling; and solids appeared in aluminum scrubber solutions when the fluoride: aluminum molar ratio exceeded 1.6. When the aluminum scrubber solutions were heated, a fluoride:aluminum molar ratio of 5.8 could be achieved with no solids formation. (Author summary modified)

47256

Tsugawa, Hiroji

TOXIC GAS TREATMENT IN ALUMINUM INDUSTRIES. (Aluminiumu sangyo ni okeru yugai gasu no shori gijutsu). Text in Japanese. Kankyo Sozo (Environ. Creation), 2(10):33-37, Oct. 1972.

A hydrogen fluoride elimination system for aluminum refining industries and treatment of toxic matter in the exhausts from the primary and secondary aluminum processing are discussed. Exhaust gas from these processes contains hydrogen chloride, chlorine, aluminum chloride, and sometimes sulfur oxides. The AlCl3 is contained in an extremely minute fume form, and the quantity depends on the temperature and force of chlorine gas blown into the aluminum solution. The exhaust gas from the chlorine treatment is sucked by a fan and is sent to the cleansing system, where, the gas is first cooled in a heat exchanger. The temperature is dropped to the degree where the use of bag filters becomes possible. The wall temperature of the heat exchanger must be kept above the dew point. The air used for cooling the gas will be used for warming the stack gas to eliminate white smoke. The flue gas is then sent to bag filters, which eliminate solid particles of AlCl3 and magnesium chloride at a temperature above dew point. The gas then is sent to a scrubber, where it is washed in 10% caustic soda.

47341

Hitachi Plant Construction Co., Ltd. (Japan)

NEW DUST COLLECTOR FOR CUPOLA FURNACE. (Kyupora-yo shingata shujin sochi). Text in Japanese. Kankyo Sozo (Environ. Creation), 2(10):72-73, Oct. 1972.

A new and unique dust collector utilizing a static electric mat filter especially designed for a cupola is introduced. It com-

bines static electricity, a mat filter, and a scrubber. Since cupola flue gas contains minute particles of fume, static electricity helps form larger particles instantly and adsorbs particles onto electrodes. The dusts are washed down by sprays. There are two layers of mat filters above the electrode sprays. The mat filters are packages of mesh filters, through which the already cleaned gas is sucked. Clogging of mesh is prevented by two more levels of sprays. Sulfur dioxide, chlorine, ammonia, and fluorine are also absorbed, and caustic soda solution in the spray water helps desulfurization action. The mist created by these sprays is eliminated by a demister layer above the mat filters. Clean air goes out from the stack at the top. A pilot plant was tested for 6 months; the first plant was constructed in August. The gas containing 0.2 g/N cu m of dusts at the exit of the cupola is cleaned to 0.08 - 0.12 g/N cu m. The construction and operation costs are also extremely favorable compared to other types of dust collectors for cupola.

47463

Hoeke, Engelbert

WET REMOVAL OF DUST FROM FLUORINE-CONTAINING EXHAUST GASES IN ALUMINUM MANUFACTURE. (Verfahren zur Nassentstaubung fluorhaltiger Abgase bei der Herstellung von Aluminium). Text in German. Fried Krupp G.m.b.H., Essen (West Germany)) W. Ger. Pat. Appl. 2,039,588. Aug. 8, 1970. (3 claims).

Dust in fluorine-containing exhaust gases from aluminum manufacture can be removed by a wash solution with a pH equal to or greater than 10.5 and a salt content of less than 6%. The salt concentration can be maintained by replenishing the washing solution with fresh water.

47466

Fritsch, Peter

RECOVERY OR REMOVAL OF HYDROGEN FLUORIDE FROM GASEOUS MIXTURES. (Verfahren zur Gewinnung bzw. Entfernung von Fluorwasserstoff aus Gasmischungen). Text in German. (Farbwerke Hoechst AG, Frankfurt am Main (West Germany)) W. Ger. Pat. Appl. 1,567,494. 4p., Aug. 16, 1962. 5 refs. (2 claims).

In a bubble-cap column or an other cascade arrangement, a mixture containing hydrogen fluoride, hydrogen chloride, and perhaps organic compounds, can be scrubbed at minus 20 to 50 C with 2-30 g water or aqueous HCl solution for each mole HF to be absorbed. A polyethylene column having 30 bubble-cap trays was filled with approximately 4 l of concentrated HCl. A gas mixture consisting of 2 cu m/hr HCl, 1.2 cu m/hr nitrogen, and 80 g/hr HF was introduced at the bottom. At the top of the column, 160 ml of concentrated HCl was introduced. The lowest two trays were maintained at minus 3 C by circulating the scrubbing liquid contained therein through an outside cooler. The gaseous mixture leaving the top of the column contained 0.0007 wt% HF based on HCl.

47677

Kemmer, Frank N.

POLLUTION CONTROL IN THE STEEL INDUSTRY. In: Industrial Pollution Control Handbook. Herbert F. Lund (ed.), New York, McGraw-Hill, 1971, Chapt. 10, p. 10-3 to 10-20.

Water requirements and typical contaminants, air requirements and contaminants, and solids handling are discussed for the steel industry. Particulates, sulfur compounds, carbon monoxide, cyanides, fluorides, and benzene compounds are the most frequently encountered air contaminants. Waste water problems are considered for blast furnaces, casting operations, foundries, open hearth furnaces, basic oxygen furnaces, electric furnaces, rolling mills, sinter plants, heat treatment, acid pickling, vacuum degassing, coke plants, slag plants, utilities, and maintenance shops. The basic cleaning devices for waste gases are simple gravity separators, wet scrubbers, electrostatic precipitators, and baghouse filters. Control device selection is considered.

47680

Spencer, Emmet F., Jr.

POLLUTION CONTROL IN THE CHEMICAL INDUSTRY. In: Industrial Pollution Control Handbook. Herbert F. Lund (ed.), New York, McGraw-Hill, 1971, Chapt. 14, p. 14-1 to 14-31.

The air pollution control measures applied in chemical manufacturing are for the most part the everyday application of chemical engineering unit operations using mechanical collectors, bag filters, electrostatic precipitators, wet collectors, absorption, catalytic oxidation, reduction, direct flame incinerators, or adsorbers, alone or in combination. The selection of the control device for the particular process is a function of the degree of control necessary, the nature of the effluent, the capital and operating costs of the control equipment, the effect of the control system on the process itself, reliability, and the ultimate disposal of the collected waste material. In addition, process or equipment modifications may be specifically incorporated to eliminate or minimize the emission of air pollutants. Emission and control methods are discussed for the manufacture of sulfuric acid, nitric acid, phosphoric acid, hydrochloric acid, sulfur dioxide, hydrogen sulfide, oxides of nitrogen, gaseous fluorides, and chlorine. Problems associated with particulate matter, solids and tars, liquids, gases and vapors, odors, and water pollution are also considered. Odor threshold values for a number of compounds are presented.

47731

Central Council for Pollution Countermeasures (Japan) Planning Committee

A PROGRESS REPORT ON A LONG-TERM VIEW OF ENVIRONMENTAL PROTECTION. (DRAFT). (Kankyo hozen choki bijon chukan hokoku (an)). Text in Japanese. 94p., 1972 (?).

The direction of environmental science technology in the future is examined. All the technical aspects of pollution control should be almost completely developed (excepting the areas of life sciences) by 1985. Treatment technology for air and water pollution is expected to be developed relatively early. But those pollutions that offend sensitivity more or less, such as noise, vibration, and bad odor, may not be controlled until later. An effective carbon monoxide elimination device is expected to be developed by 1977, and so is an economical elimination system for hydrogen fluoride; an economical catalyst for nitrogen oxides from fixed sources is expected to be realized by 1978; and pollutionless community cars (small and safe individual transportation means) will be developed by 1978. The development of process conversion methods and recycling systems will be relatively slow. Protection technology for the natural environment and analyses of pollutant influences on human bodies will be even slower. Selecting sulfur dioxide and paper pulp BOD pollution as study cases, the futures of control techniques and economic feasibility were examined. It was concluded that these problems will be solved by 1985.

47821

Levin, G. M., G. S. Pantelyat, M. A. Kutsyshin, R. B. Goncharova, and T. M. Bublay

WATER SUPPLY FOR ELECTRIC STEEL MELTING FURNACE-EMITTED GAS SCRUBBERS. (Vodosnabzheniye gazoochistok elektrostaleplavilnykh pechey). Text in Russian. Stal, no. 9:866-868, Sept. 1972. 3 refs.

Problems of the water treatment for electric-arc steel smelting furnace scrubbers are described. Such scrubbers retain 90-92% of the fine dust, 84-98% of the hydrofluoric acid, and up to 94% of the sulfur dioxide present in the furnace gas, which along with the retention of other components results in increased mineral salt and suspended matter content in the scrubber water. Various treatments and neutralization of the waste water are required for the recycling of the water within the scrubbing process. The water to be recycled should not contain more than 100-200 mg/l of suspended matter. Analyses of the recycled water a revealed sharp decline in the rate of increase of the salt content in the water by the sixth day of recycling, which is due mainly to the precipitation of calcium silicate and fluoride. It is possible to increase the specific load of the cyclone to 3 cu m/sq m/hr by combined magnetic and chemical coagulation by means of 1 mg/l of polyacrylamide.

48143

Wondraezek, W.

PLANT FOR THE ABSORPTION OF FLUORINE-CONTAINING GASES. (Anlage zur Absorption fluorhaltiger Gase). Text in German. Chem. Tech. (Berlin), 24(8):522-523, Aug. 1972.

A slotted bottom absorber was developed for the absorption of fluorine-containing gases from the fertilizer industry. For satisfactory silicon tetra-fluoride absorption, the slotted bottom has a relatively large slot area with very specific flow velocities in the slots. At a certain spray density, the deposition of fluosilicic acid is avoided. A stable dynamic bubble zone of 1200 mm height is produced which provides the required contact areas for the phases. Single-stage absorbers are used for maximum fluosilicic acid concentration of 15 to 17 mass % and for fluorine concentrations in the scrubbed waste gas of 30 to 50 mg F/cu m; for higher H2SiF6 concentrations two-stage systems are used. The absorbers presently available are designed for gas throughputs of up to 50,000 cu m gas/hr. Absorbers with waste gas quantities of up to 150,000 cu m are being developed. The operation and construction of a two-stage absorber is described. The waste gas is drawn off from the reactor by a ventilator and passed into the lower section of the first absorber where the fluorine-laden gas rises countercurrent to the washing fluid. After passage of a droplet precipitator, the preliminarily cleaned gas enters the second absorber and passes through it countercurrently to the washing fluid. A cyclone is used as second droplet precipitator where the cleaned gas is pressed into the waste gas duct.

48480

Naoi, Yasukazu

PERFORMANCE AND PROBLEMS OF AIR FILTERS IMPREGNATED WITH ALKALI. (Arukari tenchaku firuta no seino to mondaiten). Text in Japanese. Kuki Seijo (Clean Air-J. Japan Air Cleaning Assoc., Tokyo, 10(6):53-58, Dec. 1972. 3 refs.

An air filter impregnated with alkali can remove harmful gases by a chemical reaction such as neutralization of acidic gases. Sodium hydroxide and sodium carbonate are often used as alkaline agents. The alkali-impregnated filter gives a higher removal efficiency for chlorine, hydrogen fluoride, and hydrogen sulfide than normal filters. The efficiency is poor for nitrogen dioxide. Carbon monoxide and carbon dioxide can be removed in the early stages of use, but the removal efficiency drops so rapidly that it is not practical. Humidity, temperature, sulfur dioxide concentration, filter thickness, and flow rates affect SO2 removal efficiency. The filters are greatly affected by humidity, so they should be used at low humidities. Dispersal of the absorbent or substances formed as a result of the reaction should be avoided by using a flow rate of 0.5 m/sec or lower and an adhesive agent. Maintenance and disposal of used filters can also be a problem.

48805

Schwartz, Werner and Werner Eisert

EXAMPLES AND LIMITS OF COMBATING AIR POLLUTION IN COPPER PLANTS. (Beispiele und Grenzen der Reinhaltung von Luft in Kupferhuetten). Text in German. Z. Erzbergbau Metallhuettenwesen, 25(10):505-511, 1972. 6 refs. (Presented at the Gesellschaft Deutscher Metallhutten- und Bergleute Hauptuersammlung, Stuttgart, West Germany, April 28, 1972.)

Any dust and metal recovery in copper plants, as well as the reduction of emissions depends on the special type of raw copper processing plant. In preroasting plants, the waste gas quantity amounts to only 43% of that from a greenfeed plant. In the flash plant, the waste gas quantity is only 33% of that of the greenfeed plant. The large waste gas quantity of the greenfeed plant, however, contains only small sulfur dioxide and trioxide concentrations for which no economic recovery process is available. Nearly the entire amount of sulfur is discharged into the atmosphere. In the case of the preroasting plant, only 12% of the sulfur is directly emitted. Prior to any sulfur recovery, the waste gases must be thoroughly cleaned of dust and interfering components. The waste gases usually carry various pollutants along which require different collection methods. Dust and fumes are retained in hot gas electrostatic precipitators which operate at temperatures between 300 and 400 C. Volatile substances (mercury) and gaseous substances (hydrogen chloride and hydrogen fluoride) can be removed in high-capacity scrubbers. Knowledge of the developmental process of the system is necessary for an optimum solution of the gas cleaning problem. The costs depend primarily on the gas quantity to be treated. Costs rise progressively with the desired collection efficiency.

48811

Schackmann, H.

ENVIRONMENTAL PROTECTION IN METALLURGICAL PLANTS. (Umweltschutz in Huettenbetrieben). Text in German. Metall (Berlin), 27(1): 41-47, Jan. 1973.

The non-ferrous metal industry has to cope with four environmental problems, the pollution of water and air, noise, and solid waste disposal. For the production of copper, tin, and lead, as well as other non-ferrous metals, sulfur-containing ores are used. The sulfides are roasted and the developing sulfur dioxide is usually so concentrated that it can be converted to sulfuric acid. All newer plants are equipped with Bayer double catalyst plants which operate with an efficiency of 99.5%. While the entire SO2 emission in the Federal Republic of Germany amounts to between 3.5 and 4 million tons, the total emission of SO2 from sulfuric acid production is only 25,000 tons, i.e., 0.6% of the total quantity. There is no metallurgical industry today in West Germany which is not re-using the SO2. The dust emission causes greater problems in this industrial branch than does the SO2 emission. Most of the dust cleaning problems can be solved, with the exception of the

aerosols developing at the production of ferro-alloys. The most expensive problem is the removal of fluorine. Expensive cleaning plants had to be installed in new aluminum electrolysis plants whose costs amounted to 20 and 25% the total investment costs. All air pollution problems in industry can be solved, it is just a matter of costs.

48814

Wilde, G. and L. Reh

REMOVAL OF FLUORINE FROM THE WASTE GASES OF THE ALUMINUM FUSION ELECTROLYSIS IN A HEAVILY EXPANDED ALUMINUM OXIDE FLUIDIZED BED. (Fluorentfernung aus den Abgasen der Aluminium- Schmelzflusselektrolyse in stark expandierten Aluminiumoxid- Wirbelschichten). Text in German. Aluminium, 48(11):738-740, 1972. 8 refs. (Presented at the Gesellsahaft Deutscher Metallhuetten- und Bergleute, Stuttgart, West Germany, April 1972.)

A method is described for the binding of fluorine from waste gases of aluminum fusion electrolysis in a heavily expanded alumina fluidized bed. The method was first tested on a laboratory set-up. The fluorine polluted gas was drawn on by a fan and passed to the fluidized bed reactor. A constant quantity of oxide was also entered continuously. With gas velocities of 1-5 m/sec, a greatly expanded fluidized bed was formed which was maintained by returning the oxide carried off in the cleaned gas and retained in two cyclones and a subsequent bag filter. For an oxide throughput of 300 g/hr, a gas throughput of 108 cu m/hr, and a pressure loss of the fluidized bed of 150 mm water, the average gaseous fluorine concentration was reduced from 23.2 mg/cu m to 0.57 mg/cu m. The good collection efficiency of more than 97.5% was due to the long contact time between gas and solid phase and the intense mixing of the two phases. The satisfactory laboratory results lead to the erection of a scaled down experimental plant and eventually to a large scale plant for an aluminum manufacturing plant with an annual production capacity of 60,000 tons of aluminum and an hourly waste gas volume of one million cu m/hr. The waste gases are drawn off from the enclosed electrolysis furnaces and passed to two fluidized bed adsorbers. The cleaned gases are passed through a bag filter for recovery of the oxide and discharged through a 40 m high stack. The oxide throughput will amount to 750 kg/hr, and the pressure loss is expected to remain below 700 mm water over the entire facility from eletrolysis furnace to stack exit. The gaseous fluorine concentration in the cleaned gas is below 1 mg/cu m.

48879

Shirasawa, Tadao, Zenichi Kawase, and Kazuko Mizukami

THE REMOVAL OF FLUORIDES BY PACKED TOWER. (Jutento ni yoru fusso kagobutsu no jokyo ni tsuite). Text in Japanese. Japan Society of Air Pollution, Proc. Symp. Japan Soc. Air Pollut., 13th, 1972, p. 149. (Nov. 7-9, Paper 104.)

Recently the number of tile manufacturing factories have increased in northern Saitama Prefecture where mulberry trees are grown for the silkworm industry. Damages to mulberry leaves by fluoride emissions from these factories have been noticed, so fluoride control systems were installed in many of these plants. The system generally utilizes caustic soda alkaline scrubbers for the flue gas; due to the lack of an ideal waste water drainage, water is recirculated. Sodium fluoride is recovered and lime is added, producing calcium fluoride. The two kinds of systems used in this area both employ packed towers. System A employs terralette packing and two-stage net shelves in the upper part of the scrubber. The gas is cooled before entering the scrubber, which is made of plastic. System B utilizes slate tile waste as the packing material in the tower to lower cost, and the tower is made of mortar cement. It has an automatic pH adjuster in order to save manpower. These systems have eliminated most hydrogen fluoride from the flue gases of the plants. Now the concentration is less than 1 ppm at the exit. Sulfur dioxide in the emission gas is also almost completely eliminated. The damages to mulberry leaves have been successfully controlled.

49023

Stone, E. H. F.

FUME AND EFFLUENT TREATMENT PLANT IN THE NON-FERROUS METALS INDUSTRY IN BRITAIN. Int. Met. Rev., vol. 17:227-239, Dec. 1972. 116 refs.

Control technology for gaseous and liquid effluents from the non-ferrous metals industry in England is reviewed with respect to pollution legislation, emission sources within the industry, control equipment design and operation, overall costs, comparative efficiency, and liquid effluent treatment. Gaseous effluents include dark smokes, sulfur dioxide, carbon, metal oxides, sulfates, chlorides, dust, and grit generated from smelting operations or furnaces; nitrogen oxides, hydrochloric acid, cyanogens, hydrocyanic acid, solvents, fluoride and chlorides from welding and fluxes; and fumes from galvanizing operations. The basic mechanisms for dust and fume control include inertial collectors (cyclones, baffles, and settling chambers), electrostatic precipitators, scrubbers (jet-impingement, spray towers, and venturi), and filters (bag and fabric).

49031

Ross, W. K.

DESIGNING A CANADIAN REFINERY S EXPANSION TO COMPLY WITH PRESENT AND IMMEDIATELY FORESEEABLE ENVIRONMENTAL REQUIREMENTS. Preprint, 11p., 1972. (Presented at the International Pollution Engineering Congress, Cleveland, Ohio, Dec. 4-6, 1972, Paper 21.)

Plans for new pollution control measures at a refinery which will be expanded are discussed. Air pollutant emission standards for sulfur dioxide, hydrogen sulfide, carbon monoxide, particulate matter, hydrogen fluoride, and smoke are listed. Planned control measures include scrubbing raw fuel gas with amine to remove H2S and converting 92% of the H2S to elemental sulfur for sale. The rest, as sulfur dioxide, plus the flue gas from oil burning will go to a 300-foot stack. Crude oil storage tanks will be fitted with roofs to prevent the loss of hydrocarbon and H2S vapors. All H2S-bearing waters will be stored in a closed system and disposed of in a disposal well. Hydrofluoric acid transfer lines will be purged to clear them of HF vapors. The purged gas will flow to the flare through a gas scrubber to remove remaining HF vapors. After use as a catalyst, the HF will be recovered by distillation. The catalytic cracking unit is the major source of carbon monoxide and particulates. The CO will be directed to a boiler, where it will be burned to carbon dioxide. The regenerator will also be equipped with primary and secondary cyclones to remove 99.99% of the circulated catalyst particulates. Three possibilities were considered to reduce smoke when burning flared gases and oil sludges, including the installation of spare steam-driven river water and circulating water pumps, the provision of duplicate incoming electrical power lines, and the provision of a compressor on crude gas. The flares will be equipped with automatic steam injection to minimize smoke. Oily sludges will be centrifuged to remove the bulk of oil and water; and the centrifuge cake will go to a multi-hearth furnace, where it will be reduced to dry ash. The gases will pass through a chamber in which burners actuated by a smoke detector will burn the carbon in the smoke. Processes to minimize the loss of

hydrocarbons are also described. Continuous monitoring is discussed, and environmental monitors of air pollutants are listed.

49420

Hattori, Shinji

DESIGN OF GAS RECOVERY EQUIPMENT (I). (Yugai gasu kaishu sochi no sekkei (I)). Text in Japanese. Kagaku Sochi (Plant and Process), 15(2):32-41, Feb. 1973.

A method of recovering high purity hydrogen fluoride from flue gases containing a lot of HF uses a combination of ordinary gas absorption and dispersion. The waste gas from the absorption tower is led to a cleaning tower where it is washed with water. By going through the lime layer at the top of the tower, the HF in the waste gas from the recovery system is kept at less than 1 ppm. The gas led into the absorption tower is 36 mol%, the temperature at the tower inlet is 23 C. The composition of waste gases from the absorption tower is to be 1.0 vol% HF, 11.11 vol% water, and 87.89 vol% air. The waste gas volume is 3.112 kmol/hr; its composition is 0.031 kmol/hr HF, 0.346 kmol/hr water, and 2.735 kmol/hr air. Almost 99.8% of the HF is recovered. Absorption of HF in the absorption tower is 15.469 kmol/hr and absorption in the packed tower is 15.305 kmol/hr.

49477

Wesenberg, H.

GAS COLLECTION AND CLEANING IN CLOSED PREBAKED SYSTEMS. Preprint, Norwegian Society of Professional Engineers, Oslo, 11p., 1972. 2 refs. (Presented at the International Symposium on the Fluoride Problem in the Aluminum Industry, May 24-26, 1972.)

A combination of wet scrubbing with dry cleaning (bag filters) as adopted at an aluminum smelting plant in Norway for the removal of fluorides and sulfur dioxide from potline emissions is described. Neither wet scrubbing nor electrostatic precipitation proved to be sufficient to meet the requirement for a maximum external emission of 1 kg of fluorine per ton of metal in new potlines. A minimum collecting efficiency was achieved by introducing a forced inlet of the necessary ventilation air through the basement with the aid of fans so that the amount of air could be maintained at a predetermined level instead of using roof ventilation. The potroom vents are thus working with the collecting system from the pots instead of against it. The results from the first year of operation indicate that under normal conditions the cleaning efficiency will be well over 98%. The dry cleaning system seems to be relatively unaffected by variations in the fluorine content in the raw gases. The combined system of dry scrubbing and wet washing made it possible to remove at least 80% of the sulfur emission in addition to the fluorides. Maintenance of the bag filtering system is mentioned.

49929

Ross, Richard D.

INCINERATION OF PROCESS WASTES. Air Pollution Control Assoc., Pittsburgh, Pa., Proc. Air Pollut. Control Assoc. Mid-Atlantic States Sect., Semi-Annu. Tech. Conf., Edison, N. J., 1972, p. 79-85. (May 12.)

Incineration of liquid process wastes is discussed. Combustible liquid wastes generally have caloric values of 8000 Btu/lb to 10,000 Btu/lb or higher; partially combustible wastes have a heating value below 8000 Btu/lb. The characteristics of each are described and the incinerating procedure used for each is reviewed. Incinerator design criteria for each combustion process is presented. Pollutants produced in the process, including metal oxides, chlorine, fluorine, hydrogen chloride, and sulfur dioxide are reviewed. Control methods used to reduce emissions include the use of venturi and packed scrubbers and by-product recovery. New incinerating processes, their development and operation are discussed. A number of processes have been developed for the incineration of chlorinated hydrocarbons and recovery of HCl.

49979

Kantner, A. and W. Kersting

INCINERATION, A CONTRIBUTION TO ENVIRONMENTAL PROTECTION. (Muellverbrennung, ein Beitrag zum Umweltschutz). Text in German. VGB Kraftwerkstechnik, 53(1):62-68, Jan. 1973.

Great progress has been made in modern incinerators with respect to flue gas cleaning. High-capacity filters with a collection efficiency of 99% and more have been developed. They permit a reduction of the dust concentration to 150 mg/cu m flue gas. Apart from dust the waste gases from incinerators contain carbon dioxide, sulfur dioxide, hydrogen chloride, and hydrogen fluoride. Depending on the type of waste material, the emitted concentrations of HCl fluctuate between 0.2 and 0.8 g/cu m, of SO2 between 0.2 and 1.2 g/cu m, HF up to 3 mg/cu m, and 7% CO2. The most efficient means of reducing local, as well as temporal, peaks of toxic flue gas components, is the construction of high stacks. The Frankfurt and Kassel incinerators have a stack height of 110 m, the Munich incinerators of 80, 130 and 145 m, the Mannheim incinerator of 146 m, the Nuremberg incinerator of 100 m, the Stuttgart incinerator of 180 m and the Berlin-Ruhleben incinerator of 76 m. Flue gas scrubbing is technically feasible, but has the disadvantage of creating a water pollution problem. Moreover, the cooled waste gases lack thermal buoyancy. The costs for flue gas cleaning systems, extra high stacks, and other measures necessary for the operation of an incinerator without annoying the environment are estimated to amount to 12% of the investment costs of a large incinerator.

50154

Sieth, Joachim

INCINERATION: AN AIR POLLUTION PROBLEM? WAYS OF REDUCING HYDROGEN CHLORIDE EMISSIONS. (Muellverbrennung: Ein Luftreinhalteproblem? Wege zur Minderung der Chlorwasserstoff-Emissionen). Text in German. Luftverunreinigung, 1972:43-51, Dec. 1972. 11 refs.

In incinerators of West Germany, no measures are generally taken against the gaseous emissions. The incinerators are equipped with electrostatic precipitators which remove the dust from the off-gases. Measurements of the gaseous emissions from incinerators yielded a hydrogen chloride concentration of 1 g/cu m, sulfur dioxide 0.6 g/cu m, and hydrogen fluoride 10 mg/cu m. The concentration of HCl is so high that a stack incrementation is necessary. In order to give an idea of the required stack incrementation at an increase of the presently valid maximum allowable average emission value from 2 g to 2.5 g/cu m, diagrams are given in which the stack height isohypses are plotted in dependence of the waste gas volume flow, temperature, and maximum emission concentration. The needed stack height is 177 m with a waste gas flow of 300,000 cu m/hr, a maximum hourly average concentration of 2 g HCl/cu m, and a waste gas temperature of 200 C. Independent of increasing the stack height of incinerators, other measures must be taken to reduce the gaseous pollutants. They comprise the actual reduction of the pollutant, the processing of the obtained reaction products, and the disposal

of the obtained waste product by dumping, discharge into the sewer, or chemical-technical recycling. A cost calculation for the installation of an electrostatic precipitator for dust removal with HCl absorption and neutralization and evaporation of the scrubbing water yielded operating costs of $.54/ton of waste. Scrubbers are very suitable for the removal of the gaseous pollutants in incinerator off-gases.

50435

Miyazaki, Yoshitaka

PUBLIC NUISANCE PREVENTION EQUIPMENT AND RELATED WELDING TECHNOLOGY. (Kogaiboshikiki to yosetsu kanren gijutsu). Text in Japanese. Preprint, Japan Welding Assoc., Tokyo, 14p., 1973. 8 refs. (Presented at the Seminar on Plastics Used in Public Nuisance Prevention Devices and Their Processing Techniques, Osaka, Japan, Feb. 19-20, 1973.)

The construction of pollution control equipment and factors such as corrosion resistance, and mechanical strength are discussed. Corrosion resistance of plastics are generally superior to other construction materials such as stainless steel. Polyvinyl chloride (PVC), fiber glass reinforced plastic (FRP) and PVC/FRP, are used as anti-corrosion materials. Industrial sources of sulfur dioxide, hydrogen fluoride, chlorine, hydrogen chloride, and other harmful gases are listed with their disposal devices and processes. Plastic welding technology is discussed, and a non-plasticizing welding rod is recommended over an ordinary welding rod.

50652

Netzer, W. D.

FLUORINE DISPOSAL METHODS. Atomic Energy Commission, Div. of Operational Safety, Proc. AEC Pollut. Contr. Conf., Oak Ridge, Tenn., 1972, CONF-721030, p. 62-86. 27 refs. (Oct. 25-27.)

Safe and economical methods of disposing fluorine presently vented from a uranium oxide conversion facility were investigated. The facility produces uranium hexafluoride by reacting high assay uranium oxides with fluorine. The disposal processes under consideration included caustic scrubbing, fixed bed reactors, and a fluidized bed reactor. A 5 in. countercurrent spray tower was built which can absorb 90% of a standard 3 cu ft/min fluorine flow using a 2 gal/min flow of 5 wt% potassium hydroxide. But the toxic gases oxygen difluoride and nitroxy fluoride are also produced in the scrubber. Fixed bed charcoal and iron reactors were operated, but the charcoal reaction produced large quantities of carbon monoxide, carbonyl fluoride, and silicon tetrafluoride; and the iron reaction produced molten iron which plugged the reactor. Fixed bed reactor systems are hampered by high maintenance costs, and studies utilizing fluidized bed reactors are now being considered. (Author abstract modified)

50868

Hishida, Kazuo

CONTROL TECHNIQUES OF SPECIFIC TOXICANTS RELATED TO AIR POLLUTION. (Taiki osen kankei yugai busshitsu shori gijutsu). Text in Japanese. PPM (Japan), 4(4):58-79, April 1973.

Control techniques for cadmium, cadmium compounds, chlorine, hydrogen chloride, fluorine, hydrogen fluoride, silicon textrafluoride, lead, and lead compounds are outlined. Sources and characteristics of these compounds are mentioned. Particulates containing cadmium, lead, and their compounds can be easily removed by dust collectors. Efficiency, application, and selection of dust collectors are discussed. Gaseous toxicants are usually removed by liquid scrubbing or gas-solid adsorption. Characteristics of packed columns, spray towers, cyclone scrubbers, venturi scrubbers, jet scrubbers, and other scrubbers are summarized. Maintenance of control equipment and safety practices are described.

50937

Davids, P. and W. Brocke

TECHNICAL POSSIBILITIES FOR REDUCTION OF THE POLLUTANT EMISSION FROM INCINERATORS. (Technische Moeglichkeiten zur Verminderung der Schadstoffemission aus Muellverbrennungsanlagen). Text in German. Muell Abfall, 5(3):72-75, 1973. 10 refs. (Presented at the Muelltechnische Kolloquium, Stuttgart, West Germany, March 8, 1973.)

Incinerators emit hydrogen chloride, hydrogen fluoride, sulfur dioxide, and oxides of nitrogen. Since hydrogen chloride is water soluble its separation is relatively easy compared to SO2. Through scrubbing with water, cleaned gas concentrations of less then 10 mg HCl/cu m can be reached. Hydrogen fluoride, too, is water soluble. In aluminum plants, scrubbers for HF for several million cu m/hr are in operation. The cleaned gas concentrations are around 1 mg HF/cu m. For sulfur dioxide, alkaline absorbents must be used. For desulfurization, a number of processes exist, some are in operation behind steam generators. In incinerators of the Federal Republic of Germany, scrubbers for waste gas cleaning are hardly used. Extensive measurements were carried out with a scrubber in an incinerator with a throughput of 2.5 tons/hr and an off-gas quantity of 18,000 cu m/hr. The off-gas was first cooled to 70 C. In several parallel venturi nozzles the dust was separated and the water soluble gaseous components absorbed. After passage of a droplet separator, the off-gas was heated again and blown out through the stack. An average collection efficiency for HCl of 95% and for HF of 96% was obtained. The average concentrations in the cleaned gas were 27 mg HCl/cu m and 0.3 mg HF/cu m. The collection efficiency for SO2 was 7% and for NOx was 12%. Thermogravimetric and laboratory experiments concerning the sorption properties of comminuted slag from incinerators for HCl and SO2 under simulated conditions revealed that at between 500 and 700 C the slag has a large binding potential for these substances.

51101

Davids, P. and W. Brocke

TECHNICAL POSSIBILITIES FOR A REDUCTION IN THE EMISSION OF NOXIOUS SUBSTANCES FROM REFUSE INCINERATION PLANTS. (Technische Moeglichkeiten zur Verminderung der Schadstoffemission aus Muellverbrennungsanlagen). Preprint, 1973, 21p., 10 refs. (Presented at the Refuse Meeting, 24th, Stuttgart, West Germany, March 8, 1973.) Translated from German, 16p.

Control methods to reduce emissions of hydrogen chloride, hydrogen fluoride, sulfur dioxide, and nitrogen oxides from refuse incineration plants are reviewed. The design, operation, and specific application of wet scrubbing, alkaline absorbers, venturis, electrostatic precipitation, sorption, and dry stack gas purification are examined.

51720

Bakr, M. Y. and M. Hussein

PRODUCTION OF FLUOSILICATES FROM WASTE GASES OF EGYPTIAN SUPERPHOSPHATE INDUSTRY. Indian Ceram., 16(6):111-114, Sept. 1972. 4 refs.

The chemical analysis of Egyptian phosphate rock shows the fluorine content to be 3.3%. About 30% of the fluorine present in the rock is evolved during acidulation with 70% sulfuric acid. Silicon tetrafluoride is evolved as a gas during acidulation of phosphate rock with H2SO4, which reacts with water to produce an aqueous solution of fluosilicic acid. This solution is the starting material for preparation of the different metal fluosilicates. Experiments were made on the preparation of sodium and calcium fluosilicate by neutralizing fluosilicic acid with various sodium and calcium salts. Sodium and calcium chlorides are the preferred salt solutions. (Author abstract modified)

51755

Koethe, Klaus and Ludwig Mueller

DETERMINATION OF THE HYDROGEN FLUORIDE PARTIAL PRESSURES. (Beitrag zur Ermittlung von Flurowasserstoff-Partialdruecken). Text in German. Neue Huette, 18(6):332-336, June 1973. 9 refs.

The thermal treatment of zinc concentrates by a blasting process is connected with a volatilization of fluorine and arsenic. These pollutants can be romoved from the waste gases by absorption in an aqueous solution. For calculation of the absorber, the vapor pressure equilibria of fluorine-containing systems and the interference by sulfur and arsenic-containing components must be known. A literature survey on the fluoride partial vapor pressures of aqueous fluorine containing systems turned out data for the systems hydrogen fluoride water, HF-fluosilicic acid-sulfuric acid, and H2SiF6-H2. No data concerning the partial pressures for concentrations below 10 g F/l and temperatures between 20 and 60 C, whose knowledge is essential for the absorber calculation, were found. Therefore, the HF partial pressures of binary and ternary systems for concentrations between 0.1 and 10g F/l and temperatures between 20 and 60 C were determined. For the system HF-H2O, a vapor pressure equation is given. The fluorine concentration in the absorption solution depends solely on the HF partial pressure of the system HF-H2O. The influence of the compounds H2SiF6, H2SO4, sulfur dioxide, arsenic trioxide, and arsenic pentoxide is negligible. The fluoride concentrations in the gas cleaned by a wet process are determined by the HF concentration in the absorption solution and by the temperature on the last absorption stage.

51845

Behrens, D.

ENVIRONMENTAL PROTECTION: A CHALLENGE FOR CHEMICAL ENGINEERING. Chem. Engr. (London), 9(271):143-150, March 1973. 4 refs. (Presented at Europe - The Differences, Symposium of the Midlands Branch, Birmingham, England, April 18-19, 1972.)

The amounts of major air and water pollutants and solid waste generated by the main sectors of West German Industry in 1969/1970 are shown. Specific tasks for the chemical engineer in the field of air pollution include large-scale testing of flue gas and fuel oil desulfurization problems and the development of processes, such as sorption, ozonization, and ultraviolet irradiation for control of malodorous substances. Other effluent gas problems are thermal catalytic combustion of large effluent gas flows, purification of gases containing hydrogen fluoride from aluminum smelters and ceramic works, as well as the disposal of nitrogen oxides from combustion engine exhausts. Effective effluent control will require removal of traces of heavy metals and treatment of substances resistant to biological degradation. The chemical engineer can contribute to treatment of municipal rubbish by systems analysis of alternative processing systems and by rendering plastics subject to complete combustion or biological degradation. Protection of the environment must also be considered in the stage of process development. There is yet no feasible method of producing detergents without triphosphates, but alternatives to insecticides are under study, including the use of sterilants, the sexual attraction mechanism, and juvenile hormones. Blending of grafting of more readily macromolecular compounds in synthetic polymers and plasticizers may speed up the biological degradation of plastics.

52094

Wickes, H. G., Jr. and J. B. Whitchurch

FLUORINE CONSUMPTION TRENDS OF THE ALUMINUM INDUSTRY. Preprint, American Inst. of Mining, Metallurgical, and Petroleum Engineers, New York, Society of Mining Engineers, 21p., 1973. 10 refs. (Presented at the American Institute of Mining, Metallurgical, and Petroleum Engineers, Annual Meeting, Chicago, Ill., Feb. 25- March 1, 1973, Paper 73-H-50.)

The factors and trends of fluorine consumption in the aluminum industry during the next decades are discussed. Virtually all fluorine consumed by the aluminum industry is as the electrolyte of the Hall-Heroult process for producing primary aluminum. A small amount of fluorspar is used, but most fluorine is consumed as either aluminum or cryolite. Some fluorine-containing materials are used in secondary aluminum production. Increasingly stringent restrictions on the emission of pollutants and the continuing cost-price squeeze factors are taken into consideration in the analysis of the future of the primary aluminum industry. In the future, much more fluorine will be recycled, thereby reducing the demand for new fluorine. Hydrogen fluoride fume scrubbing and fluoride recovery are discussed in detail. Fluoride recovery is also economically evaluated.

52172

Muhlrad, W. and A. Chauvineau

PECHINEY/PRAT DANIEL DRY PROCESS FOR CONTROL OF FLUORINE COMPOUNDS RELEASED BY ALUMINUM REDUCTION POTS. Preprint, American Inst. of Mining, Metallurgical, and Petroleum Engineers, New York, Metallurgical Society, p. 209-222, 1973. 8 refs. (Presented at the American Institute of Mining, Metallurgical, and Petroleum Engineers, Metallurgical Society, 1973, Paper A73-16.)

A process for controlling fluorine emissions from aluminum reduction pots is based on adsorption of fume by alumina. The pot fume is brough into contact with alumina injected into a venturi tube installed at the bottom of a vertical duct which conveys the alumina/fume mixture to a bag filter unit. The fluorinated alumina is collected and recycled to the venturi tube or the reduction pots. The process configuration operates on a small pressure drop, so energy expenditure is minimal. Process efficiency is directly related to alumina surface area and is 99.5% when the area is more than 20 sq m/g. Operating experience with a commercial unit used to treat fume from 20 pots operating at 130,000 A is discussed.

52179

Rooth, R., K. O. Hagen, O. K. Beckman, and G. Walker

CONTROL OF INTERNAL AND EXTERNAL ENVIRONMENT IN THE PRIMARY ALUMINUM SMELTING INDUSTRY. Preprint, American Inst. of Mining, Metallurgical, and Petroleum Engineers, New York, Metallurgical Society, p. 341-349, 1973. (Presented at the American Institute of Mining,

Metallurgical, and Petroleum Engineers, Metallurgical Society, 1973, Paper A73-24.)

External and internal control of total fluorine and fluorides in aluminum pot rooms is discussed. Fume collection efficiencies of VS Soderberg pots, open pots with prebaked anodes, and hooded pots with prebaked anodes are, respectively 70, 0, and 90-95%. Medium-pressure fluidized bed scrubbers are frequently used to clean the primary gases from Soderberg and hood prebaked pots. Cleaning efficiencies on total fluorine are 97% on Soderberg gas and 85% on gas from hooded prebaked pots. High-pressure scrubbing of hooded pot gas is necessary to obtain 95% total fluorine cleaning efficiency. Fine particulate fluorides are collected with 97% efficiency by bag filters. For smelters that have based their fluorine economy on wet systems with cryolite recovery, a bag filter installation followed by a low-energy wet scrubber may be the optimal solution. Water tank model studies of air flow patterns are necessary to optimize pot room ventilation with a minium of air. Such studies are particularly important for rooms with open pots and VS Soderberg pots, where 100 and 30%, respectively, of the fumes are emitted on the pot room.

52445

Kozima, Yaichi and Yoshisuke Nakamura

DEFLUORIDIZATION AND DESULFURIZATION FROM FLUE GAS IN A TUNNEL KILN IN FIREPROOF BRICK FACTORY. (Taikarenga kojo ni okeru haien daffutsu datsuryu ni tsuite). Text in Japanese. Kogai to Taisaku (J. Pollution Control), 9(6):621-624, June 1973. 3 refs.

The cause of withering of grape leaves in Okayama Prefecture was fluoride-containing flue gas emitted by a fireproof brick factory. Several defluoridization/desulfurization processes were tested to find one that could give 99.5% or higher defluoridization efficiency, low water consumption, low fluorine content in the waste water, less sludge, and cheaper running costs. The most suitable process involved absorption of the sulfur oxides and fluorides with sodium hydroxide. Absorbent was recirculated and fluorine and particulates were removed from the absorbent. The process gives 99.6-99.9% defluoridization efficiency and 94-98% desulfurization.

52838

Iversen, R. E.

AIR POLLUTION IN THE ALUMINUM INDUSTRY. J. Metals, 25(1):19-23, Jan. 1973. 3 refs.

Gaseous and particulate fluorides are the most serious pollutants from aluminum electrolytic reduction plants. The greatest source of pollutants of all types is normally at the individual cells or potlines, followed by the anode bake plant. In 1970 controlled emission prebaked potlines released 51% of the industry s total fluoride emissions. The greater portion of these prebake potlines employed only primary control systems (i.e., floating beds, spray towers, impingement baffles, cyclonic towers, packed towers, bubble towers, and venturi scrubbers preceded by mechanical collectors, multicyclones, or dry electrostatic precipitators for particulate removal). Control efficiency was 78% of cell emissions. Control efficiency of 85% was obtained for prebake lines employing both primary and secondary (i.e., spray screens and packed beds) systems. For vertical stud Soderberg cell production, overall fluoride collection efficiency was 78% for lines using primary collection only and 95% for lines using both primary and secondary control. All horizontal stud Soderberg production occurred on lines with primary collection only; overall collection efficiency was 70%. The use of primary and secondary control systems can reduce prebake plant emissions to 1.60 lb fluorides and 5.0 lb particulates/ton of aluminum; vertical stud Soderberg emissions to 2.8 lb fluorides and 9.1 lb particulates; and horizontal stud Soderberg emissions to 3.60 lb fluorides and 12.30 lb particulates. The estimated capital investment for installed controls on potlines is $240 million; operating costs are about $65 million/yr.

52852

Ishiyama, Koichi

WASHING TOWER FOR EXHAUST EMISSIONS USING FRP - ITS OPERATION AND MAINTENANCE. (FRP o tsukatta haigasu senjo sochi - sono unten to hoshu). Text in Japanese. Kagaku Kojo (Chem. Factory), 17(7):82-86, July 1973, 7 refs.

A gas washing tower was designed to remove sulfuric acid, hydrocyanic acid, hydrochloric acid, chromic acid, and fluorine emitted in the surface finishing process. The tower is made from fiber glass reinforced bisphenol type polyester (FRP), a strong, corrosion-resistant material. The tower is a liquid packed type. Inspection and maintenance are relatively simple, since the corrosion-resistant FRP requires no protective coating and since the packing material is made from rolled polyvinyl chloride film. The costs are less than normal. Cost of a washing tower for H2SO4 and H2CrO4 removal is a function of the flow rate. The absorption efficiency of H2CrO4 mist is a function of the liquid/gas ratio at the constant gas space velocity of 1.2-1.5 m/sec. An absorption efficiency of more than 95% occurred at 1.0 and 2.0 liquid/gas ratio. The washing tower is very effective in reducing chromic acid emission to less than the emission standard of 1 mg/N cu m.

53603

Teller, Aaron J.

PROCESS FOR RECOVERY OF ACID GASES. (Teller Environmental Systems, Inc., New York) U. S. Pat. 3,721,066. 4p., March 20, 1973. 4 refs. (Appl. Dec. 29, 1970, 10 claims).

A process for the removal and recovery of acid gas components such as hydrogen fluoride, silicon tetrafluoride, and sulfur dioxide from waste gases produced in the manufacture of glass, fertilizer, or aluminum during electrolysis is accomplished by passing the gases over a finely divided natural ore known as nepheline syenite. The nepheline syenite is desirably in the form of particles ranging in size from 4 to 500 mesh. Particles are preferably 200 to 325 mesh for bag filters, 6 to 14 mesh for fixed or moving bed applications, and 200 to 500 mesh for pipeline reactions. The sorbant properties of the nepheline syenite can be substantially improved by treating the syenite with 10 to 50 lbs of water per 100 lbs of syenite at ambient conditions. The finely divided nepheline syenite may be employed in the form of a fixed or a moving or a fluidized bed through which a stream of gas containing the acid components is passed. The gases desirably pass through the bed at a temperature of 100 to 400 F and preferably from 100 to 200 F. The space velocity of the gas should range from 100 to 10,000,000/hr and preferably from 10,000 to 1,000,000/hr. The preferred process temperatures and space velocities depend upon the concentration of the acid gases, the thickness of the bed of sorbing medium, the average particle size of the sorbing medium, and the amount of acid gases already sorbed.

53620

Predikant, Hans H.

PROCESS FOR PURIFYING INDUSTRIAL WASTE GASES CONTAINING HYDROGEN FLUORIDE. (Universal Oil Products Co., Des Plaines, Ill.) U. S. Pat. 3,709,978. 4p., Jan. 9, 1973. 7 refs. (Appl. Nov. 9, 1970, 6 claims).

A multi-stage, continuous process for scrubbing a waste gas stream containing such components as hydrogen fluoride, fluorine, sulfur dioxide, and aluminum dust generated during the production of aluminum from alumina has been developed for obtaining improved purities of the treated waste gases. The present method is capable of purification to a maximum content of hydrogen fluoride not exceeding 1 mg/N cu m. The waste gases are subjected to a first washing zone by means of a recycled aqueous hydrogen fluoride-containing solution and to a second washing zone by means of a recycled aqueous solution. Aqueous HF is transferred from the first washing zone to a neutralization zone where it is neutralized by means of aqueous sodium hydroxide or sodium carbonate. The sodium fluoride formed is separated, and the mother liquor is recycled as the first washing liquid. The aqueous HF for the first washing zone is enriched by recycling to a content of from 1.0 to 2.9% by weight, while the aqueous solution of the second washing zone is adjusted to maintain a content of from 0.01 to 0.5% by weight of free HF. The purpose of controlling the wash streams is to prevent too much HF from reaching the second stage where sodium fluoride would precipitate and block valves and piping. Treatment of the combined effluent from each wash stage in a neutralization zone accomplishes precipitation of sodium fluoride, sodium sulfate, and entrained dust or aluminum particulates.

53867

Kayama, Takao

REMOVAL AND RECOVERY OF FLUORINE COMPOUNDS. (Fusso kagobutsu no jogai to kaisyu ni tsuite). Text in Japanese. Kogai to Taisaku (J. Pollution Control), 9(4):395-402, April 1973. 7 refs.

The emission, removal, and recovery of fluorine compounds such as hydrogen fluoride and silicon tetrafluoride from glass fiber industries are discussed. The emission standards of fluorine and HF are tabulated. The dry and wet removal systems can be used to remove fluorides. Emitted HF concentrations are 540 ppm without a control system and 1.4 ppm after the stack gas goes through a dry removal system. The latter is less than the 11.2 ppm emission standard.

53868

Kawase, Zenichi

REMOVAL OF FLUORIDES IN ROOF-TILE-KILN. (Kawara seizokojo ni okeru fussokagobutsu no jogairei). Text in Japanese. Kogai to Taisaku (J. Pollution Control), 9(4):389-393, April 1973.

On roof-tile-kiln company uses a washing tower and settling tanks to remove fluorides from waste gases. The temperature of the gas is lowered to 80 C near the inlet of the washing tower by a long cooling path. The pH of the absorbing solution is controlled to more than 8 by adding sodium hydroxide. Thus, the concentration of hydrogen fluoride in the gas can be decreased from 5.8-11.2 ppm to 0.3-0.9 ppm, and 100 ppm of sulfur dioxide can be removed. Another company uses a washing tower, two circulating tanks, and a settling tank to remove HF. The gas temperature is lowered to 100 C by a shower, and the pH of the absorbing solution is controlled to higher than 7 with HaOH. When a solution of sodium fluoride occurs in the circulating tanks, one tank is stopped, and the solution is transferred to the settling tank where fluoride is settled in the form of calcium fluoride by adding slaked lime. The concentration of emitted fluoride can be decreased from 6.8 ppm to 0.8 ppm, and SO2 is decreased to less than 1 ppm.

53875

Shirasawa, Tadao

ABATEMENT OF AIR POLLUTION CAUSED BY FLUORIDE AND PROBLEMS. (Fussokagobutsu no jokyo to sono mondaiten). Text in Japanese. Kogai to Taisaku (J. Pollution Control), 9(4):367-373, April 1973.

Emission standards, removal and recovery methods, and measurement methods for fluorides emitted from an aluminum smelter are discussed. In Japan there are two emission standards for fluorides: the weight concentration standard (mg/cu m) and the total amount standard. Since the weight concentration can be easily lowered by diluting the air, the total amount is a more effective standard. A dust collector and a scrubber are usually used for collection of particulate and gaseous fluoride, respectively. A combination of these methods gives more effectiveness. Corrosion of collection equipment must be avoided during removal of hydrogen fluoride. Calcium hydroxide, sodium hydroxide, sodium sulfate, and limestone can be used to absorb HF.

54310

Predikant, Hans H., Hermann Betz, and Johann Schaeffer

PROCESS FOR PURIFYING INDUSTRIAL WASTE GASES CONTAINING FLUORINE VALUES. (Universal Oil Products Co., Des Plaines, Ill.) U. S. Pat. 3,660,019. 5p., May 2, 1972. 6 refs. (Appl. Jan. 29, 1970, 6 claims).

A continuous process for removing fluorine and hydrogen fluoride from industrial waste gases evolved in the manufacture of aluminum through electrolysis of alumina in the presence of cryolite has been developed to avoid precipitation of sodium fluoride within the washing zone by the neutralization of the main amount of hydrogen fluoride in a separate neutralization zone. The waste gases are scrubbed within a first washing zone with aqueous hydrogen fluoride and within a second washing zone with aqueous sodium hydroxide. The effluent of the first washing zone is then recycled to the first washing zone until the concentration of hydrogen fluoride is as least about 3% by weight, while the effluent of the second washing zone is recycled to the second washing zone to enrich sodium fluoride as long as the concentration of sodium fluoride within the aqueous sodium hydroxide is still below the solubility product. The concentrated effluents from both washing zones are then combined within a neutralization zone, and the precipitated sodium fluoride is separated from the mother liquor which is recycled to the first washing zone.

54799

Connor, J. M., G. J. Dell, and D. J. Newman

POLLUTION CONTROL IN ACID PLANTS. Chem. Age India, 23(2): 103- 116, Feb. 1972.

Pollution control problems and processes are reviewed for plants engaged in the production of sulfuric acid, phosphoric acid, and nitric acid. Incomplete conversion of sulfur dioxide to sulfur trioxide is the fundamental difficulty for sulfuric acid-producing plants. The most successful approach to this problem on a commercial scale has thus far proven to be the Double Absorption process in which an intermediate absorption stage is incorporated between two of the catalyst stages. Fluorides released during rock digestion and acid concentration are the main problems in phosphoric acid production. These emissions can be minimized by use of properly designed scrubbers, and recovery can provide a valuable by-product. Most nitric acid plants discharge tail gas containing 1500 to 3000 ppm by volume of nitrogen oxides if no treatment is provided. Catalytic combustion is the only abatement method now

in operation at nitric acid plants, and the difficulty experienced with combustor catalysts, as well as the still uncertain life of new ones offered, has led to renewed interest in other methods of minimizing nitrogen oxide emissions.

55046

Schoeck, Vincent E.

FILTER FABRIC--THE HEART OF THE SYSTEM. Air Pollution Control Assoc., Pittsburgh, Pa., Proc. Spec. Conf. Des. Oper. Maint. High Effic. Contr. Equip., St. Louis, Mo., 1973, p. 103-117. (March 29-30.)

The development, application, and problems of filter fabrics are described. The growth in the use of fabric filters, and the evolution of various equipment types (cleaning methods) can be tied directly to the development of new fibers and their conversion to various fabrics, woven and felted, suitable for use in fabric filters. Prior to 1946 there were two basic fibers used in dust collectors. Both fibers were natural fibers, cotton and wool, both had low recommended operating temperatures. Polyamides were introduced prior to the war, but began to have filter fabric significance with their availability after World War II. In 1955 polyester fibers became commercially available. This fiber type is today the most widely used of all synthetic types available. In 1964 Teflon and Nomex came into existence and initial filtration usage began. Tables are presented to rate the various fibers relative to each other based on heat, abrasion, and chemistry. Temperature capability ranges from 180 F for polypropylene to 525 F for fiberglass. The real problem most often experienced is acid attack. Nomex is attacked by sulfur trioxide in a high oxygen content atmosphere even when moisture is low. Sulfuric acid is detrimental to most of the high temperature fibers, as polyester and Nomex, but not to fiberglass. Hydrofluoric acid is detrimental to polyester, Nomex, and glass. Periodic precoating with lime will absorb sulfur dioxide and SO3 providing some protection to the filter fabric. Proper construction and selection of the filter fabric assures quality performance. The type and size of the pollutant determines the type of fabric. The wrong fabric can severely reduce effectiveness.

55180

Rhodes, D. W.

CHEMICAL DEVELOPMENT WORK IN SUPPORT OF FLUIDIZED-BED CALCINATION OF RADIOACTIVE WASTES AT THE IDAHO CHEMICAL PROCESSING PLANT. Allied Chemical Corp., Idaho Falls, Idaho, National Reactor Testing Station, Atomic Energy Commission Contract AT (10-1)-1375 S-72-1, 23p., Aug. 1973. 23 refs. NTIS: ICP-1025

Chemical development work in support of fluidized bed calcination of radioactive wastes at the Idaho chemical processing plant is reported. Aqueous radioactive wastes are routinely converted to granular solids by calcining in a fluidized bed calciner at 400-500 C. Wastes calcined to date include acid aluminum nitrate, acid zirconium fluoride, acid deficient ammonium nitrate, and acid stainless steel sulfate. Significant chemistry development work was performed to make possible the calcination of these wastes. The formation of alpha instead of amorphous alumina is possible by the addition of boric acid to the feed solution. Volatilization of fluoride, sulfate, and ruthenium was prevented by adding calcium nitrate to the waste prior to calcination. Complete decomposition of ammonium nitrate was obtained by blending it with acid aluminum nitrate waste. Potential volatilization of mercury was removed in the wet scrubbing system. Acid sulfate waste was blended with aluminum nitrate solution to form aluminum sulfate which is stable during calcination. If the sulfate volatilized, it could concentrate in the scrubbing solution and corrode the stainless steel equipment. Other problems associated with the calcination process that currently are being studied include agglomeration in the bed during calcination of sodium nitrate containing wastes, and possible volatility and concentration of chloride in the scrubbing solution during calcination of wastes containing low concentration (greater than 2 g/l) of chloride. (Author abstract modified)

55524

Bug, Walter

PURIFICATION OF WASTE GASES FROM ALUMINUM MANUFACTURE BY FUSED SALT ELECTROLYSIS. (Verfahren und Vorrichtung zum Auswaschen von Abgasen aus der Aluminiumgewinnung durch Schmelzflusselektroylse). Text in German. (Gebrueder Giulini GmbH, Ludwigshafen (West Germany)) W. Ger. Pat. Appl. 2,140,032. 9p., Aug. 10, 1971. (4 claims).

The purification of waste gases from aluminum manufacture by fused salt electrolysis is described. The gases are scrubbed in an absorption apparatus containing filters with rotating sprayers. They are driven by the pressure of the scrubbing water to effectively remove gaseous fluorine compounds and dust 98.5 and 85%, respectively.

55678

Schmidt, Ernst

EXPERIENCES WITH MEASURES TAKEN TO ABATE AIR POLLUTANT EMISSIONS. (Erfahrungen mit Massnahmen zur Verminderung der Emission luftverunreinigender Stoffe). Text in German. Ziegelind. (Weisbaden), no. 9:325-334, Sept. 1973. 11 refs.

Effectiveness and cost of various devices and installations used to abate air pollutant emissions at brick factories are discussed in detail. The differentiation is made between emission and immission, illustrated by showing the diffusion of flue gases using a long time exposure. Sulfur dioxide, fluorine, and aluminum emissions are described. The sulfur content found in emissions varied between 0.1 and 2 g/cu m in the form of SO2. The legal apsects of standards, rules, and regulations concerning the maximum allowable pollutant emissions are discussed. The maximum emission standards in Germany are 0.750 mg/cu m SO2 for short emissions and 0.4 mg/cu m for long ones. they are 0.005 mg/cu m and 0.002 mg/cu m for fluorine respectively. The normal allowed pollutant concentration limit is 0.350 mg/cu m SO2 and 0.003 mg/cu m fluorine. Decomposition of lime leads to generation of calcium oxide and carbon dioxide. Lime disintegration depends on the temperature. The mean values of fluoride and SO2 at kilns fired with coal, heavy oil, light oil, and gas are 48 mg/N cu m fluoride, and 0.49 g/N cu m SO2. Various types of dry absorption and wet scrubber installations are described.

56057

Quarles, John

NONFERROUS METALS MANUFACTURING POINT SOURCE CATEGORY. PROPOSED EFFLUENT LIMITATIONS GUIDELINES. Federal Register, 38(230):33170- 33183, part 2, Nov. 30, 1973.

The control of pollutants which develop during the manufacture of nonferrous metals are discussed in a notice on effluent limitation guidelines. Most of the waste waters from primary aluminum smelting result from air pollution control devices which employ wet scrubbers to control air emissions. The sig-

nificant pollutants are fluorides, suspended solids, oil and grease, cyanide, and pH. The significant pollutants in the waste water from bauxite refining include alkalinity, pH, total dissolved solids, and suspended solids. Secondary aluminum smelting pollutants include suspended solids, lead, manganese, and oil and grease. In the primary aluminum industry the most significant reduction in discharge volume is obtained by converting wet fume scrubbers to dry fume scrubbers or by treating and recycling the water from wet scrubbers. The dry scrubbing of pot gas is effective for removal of pollutants from the gases evolved from the electrolytic cell by contacting the gases with dry alumina to effect the adsorption of pollutants and subsequent collecting particulates by fabric filtration. The fumes formed during chemical magnesium removal can be controlled by either wet or dry methods. Three most popular methods which use little water are the Derham process, Alcoa process, and Teller process.

56064

Otey, M. G. and H. Pulley

DETERMINATION OF GASEOUS FLUORINE IN AIR. Am. Ind. Hyg. Assoc. J., 34(9):418-420, Sept. 1973. 2 refs.

The efficiency of a caustic scrubbing technique for determining trace quantities of elemental fluorine in air was investigated. A recovery of 98% was obtained with a single scrubber for concentrations studied in the range of 3-4480 ppb. Depletion of the sodium hydroxide in the scrubber by other acid gases in the air was not a factor as long as excess caustic was present. Conversion of the sodium hydroxide to sodium carbonate through reaction was atmospheric carbon dioxide reduced the efficiency only slightly. (Author abstract modified)

56078

Reimer, H.

FLUE GAS SCRUBBING AFTER INCINERATORS. (Rauchgaswaesche nach Muellverbrennungsanlagen). Text in German. VGB Kraftwerkstechnik, 53(11):735-742, Nov. 1973. 6 refs.

The extent and effect of the major pollutants emitted by incinerators are reviewed. A reduction of the pollutant emission particularly with regard to hydrogen chloride and hydrogen fluoride is important. Design and operation of some scrubbers, e.g., radial flow, countercurrent flow with and without installations, Stroeder scrubbers, and venturi scrubbers, are discussed. As a consequence of the high solubility of HCl in water, no major problems are encountered with scrubbers. With reaction times of less than one second, most familiar scrubbers are capable of reducing the HCl concentration to the demanded 100 mg/cu m (new version of the VDI guideline 2114). The calculatory design of the scrubber poses difficulties. Countercurrent scrubbers with water atomization are most suitable with regard to investment and operating costs. Venturi scrubbers and packed towers don t seem to be necessary, at least not for HCl absorption. Since the scrubbing process takes place at temperatures below 100 C, a cooling of the gases is necessary. Heat utilization is advisable for reasons of economy and environmental protection. Design and testing program of a flue gas scrubbing facility in the incinerator Hamburg I are described. First results of measurements of the plant which has been in operation since May 1972 are given. Apart from the physical absorption of HCl by water, the chemical adsorption by dust (dolomite, quicklime, and magnesium oxide) was studied. The results permit the conclusion that considerable amounts of HCl can be bound this way. The investment costs for scrubbers are proportional to the entering flue gas volume. They increase relatively little with increasing capacity so that there is little impetus for a combined treatment of the flue gases from several units. It seems to be better not to exceed the capacity of one scrubber of 50,000 cu m in major proportions. For larger volumes, several scrubbers should be operated in parallel, this increases the availability of each unit. The operating costs cannot yet be given in exact terms, estimates run over $1/ton of refuse.

56528

Sparwald, Volker

STUDY OF THE VOLATILIZATION OF ACCOMPANYING ELEMENTS AT ALUMINUM FUSION ELECTROLYSIS. (Beitrag zur Verfluechtigung der Begleitelemente bei der Aluminium-Schmelzflusselektrolyse). Text in German. Erzmetall, 26(11):529-533, Nov. 1973. 12 refs.

Total encapsulation of the furnaces for experimental fusion analysis by a pilot plant for adsorption of fluorine compounds on aluminum oxide permitted the study of the volatilization of important elements such as silicon, iron, titanium, phosphorus, vanadium, zinc, and gallium. The adsorption process for fluorine has been extensively described earlier. It is based on the formation of a fluidized bed between aluminum oxide and waste gas. The process reduces the gaseous fluorine to a residual concentration of 1 mg/cu m. The major disadvantage of the method is that together with the retained fluorine volatile fractions of the above elements are returned to the furnace where they reduce the quality of the metal by 0.05 to 0.06%. The dry waste gas cleaning method developed by Lurgi requires only 10% of the oxide consumed by the furnaces for the fluorine adsorption. This has the advantage that the volatile pollutants are concentrated in a relatively small oxide quantity which limits the reduction of the metal quality to only part of the production.

56531

Nissan Engineering Co., Ltd. (Japan)

WET TYPE NITROGEN OXIDES REMOVAL METHOD. (Chissosankabutsu no shisshiki jokyoho). Text in Japanese. Preprint, Japan Petroleum Inst., Tokyo, 14p., 1973. 1 ref. (Presented at the Japan Petroleum Institute, Meeting on NOx Reduction, Tokyo, Japan, Aug. 29-30, 1973.)

The NE wet denitration process uses a solution of permanganate as an oxidation/absorption agent for removal of nitrogen oxides in waste gas. It removes both nitrogen dioxide and nitric oxide, as well as hydrogen chloride and hydrogen fluoride. A waste gas of 2000 cu m/hr with an NOx concentration of 4000 ppm or less gives only 100 ppm or less NOx after denitration. It is not difficult to reduce the NOx content further to only 20 ppm. No secondary pollution occurs.

56591

Schmidt, Ernst

IS A SOLUTION OF THE FLUORINE EMISSION PROBLEM IN THE BRICK INDUSTRY IN SIGHT? (Ist eine Loesung des Fluor-Immissionsproblems in der Ziegelindustrie in Sicht)? Text in German. Luftverunreinigung, 1973:38-46, 1973. 6 refs.

The dry injection of calcium hydrate (calcium hydroxide) in brick kilns was tested. The method aims at the reduction of the oxides of sulfur and particularly of the aggressive fluorine compounds. First the injection of the pulverized substance directly into the kiln was tested to see whether a reduction of the SOx present in high concentrations in the flue gas indirectly also reduces the fluorine emission. Earlier studies had shown that the driving off of fluorine compounds from brick

parts was greatly influenced by the concentration of sulfur dioxide. The fluorine emission could be considerably reduced. The direct contact of the brick material with the pulverized calcium hydrate permitted the application of this method only for products which require no pure color. Very favorable results were achieved with the injection of only 1/3 of the calcium hydrate into the furnace and 2/3 (of a total of 5 kg/hr) into the smoke collector leading to the stack. The fluorine emission could be reduced from the long-term average if 70 mg/cu m waste gas to less than 3.5 mg/cu m, which is a reduction of more than 95%. Similar favorable results were achieved with the sole injection of the calcium hydrate into smoke flue outside the furnace provided the reaction path was sufficiently long. Through this the dust emission may be increased to beyond the existing limit concentrations. The problem of a suitable dust collector in this case remains to be solved.

57706

Cochran, C. Norman

RECOVERY OF HYDROGEN FLUORIDE FUMES ON ALUMINA IN ALUMINUM SMELTING. Environ. Sci. Technol., 8(1):63-66, Jan. 1974. 17 refs.

The adsorption of hydrogen fluoride fumes from aluminum smelting on alumina was studied. Calcined aluminas with widely ranging surface areas rapidly chemisorbed a monolayer of HF at partial pressures of a few micron in Al smelting fumes at 120 C. The chemisorbed layer contained two HF molecules/surface Al2O3 molecule and converted aluminum fluoride to a crystal above 300 C. Additional HF physisorbed at higher partial pressures was mostly desorbed on heating above 120 C. Adsorption isotherms were derived from data for processes in which the fumes were contacted with calcined Al2O3 for recovery of fluorides. The fluoride- containing Al2O3 was fed to the Al smelting cell for electrolysis to close the fluoride fume generation and recovery loop. This lowered the AlF3 requirements of Al smelting to essentially that for converting the sodium oxide impurity (introduced with the Al2O3) to a fluoride bath of the desired composition. The HF was generated near the 975 C smelting temperature by reaction of AlF3-containing species with moisture. The reverse reaction favored at lower temperatures was the basis for the recovery process. (Author abstract modified)

58380

Kawasaki, Gunji, Masao Yamasaki, Yasutaka Hosono, Hisao Arakawa, Yukio Aburamoto, and Masami Imai

ON FLUORIDES IN EXHAUST GAS (2). (Fusso kagobutsu hasseigen chosa ni tsuite --sono 2--tekko kanren kojo hasseigen chosa). Text in Japanese. Taiki Osen Kenkyu (J. Japan. Soc. Air Pollution), 8(3):362, 1973. (Presented at the Japan. Society of Air Pollution, Annual, Meeting, 14th, Fukushima, Japan, Nov. 6-8, 1973, Paper 106.)

Six iron and steel factories were investigated for fluoride emissions. Four factories had traceable amount of F in stack gases; one factory with a 25-ton electric furnace utilizing 1-2 kg/ton of steel, had 1.6 mg/N cu m of F, and another factory with one furnace of 40 ton utilizing 10 kg/ton of steel and another furnace of 10 ton capacity utilizing 8 kg/t produced stack gas containing 41.9 mg/N cu m of F. In both factories, the flue gases are treated by bag filters. The highest amount of F was emitted immediately after fluorite is thrown into the furnace, and that reduction of the amount of CaF2 and eliminating gas at the initial stage of CaF2 melting together with slug will decrease F emission considerably. When the treatment was adopted the CaF2 consumption was decreased from 18 kg/ton to 1.4 kg; F emission decreased from 41.9 to 1.3 mg/N cu m.

58466

Gopalachari, A. S.

RECOVERY OF FLUORINE FROM THE WASTE GASES OF PHOSPHATIC FERTILIZER PLANTS. Chem. Age India, 22(10):677-683, Oct. 1973. 4 refs.

When raw rock phosphate is treated for fertilizer production, fluorine escapes in the form of waste gases. Since this is normally the loss of a valuable by-product, particularly in the context of ever increasing demand for cryolite, aluminum fluoride, and a wide range of fluorine chemicals, a process was developed to recover the fluorine from the above source. The by-product recovery of fluorine also improves the environment by reducing fluorine pollution. The availability, consumption, and demand for fluoride compounds, the composition of commercial raw phosphates, the distribution of phosphate fertilizer plants in India according to rock phosphate consumption, the principal phosphatic fertilizer/phosphoric acid plants in India during 1972, the process for recovering fluorine from waste gases, and licensed and installed capacity for synthetic cryolite production and for sodium silico fluoride based on fluorine gases from phosphatic fertilizer plants are described.

58632

Zaytsev, V. A., V. I. Rodin, B. V. Gromov, L. N. Arkhipova, V. N. Senin, A. A. Novikov, and T. G. Repenkova

WASTE PRODUCTS FROM THE PRODUCTION OF PHOSPHATE FERTILIZERS AS POSSIBLE RAW MATERIAL FOR FLUORINE PRODUCTION. Soviet Chem. Ind. (English translation from Russian of: Khim. Prom.), no. 547-550, Aug. 1971. 22 refs.

The main mineral from which fluorine compounds are obtained is fluorspar. Fluorspar ores are categorized as chemical, metallurgical, and ceramic. The ever-increasing demand for fluorine compounds has increased the mining of fluorspar and decreased the fluorspar reserves. Thus new sources of fluorine are being studied, including apatite, a raw material for producing phosphate fertilizers. The fluorine content of apatite varies from 1.3-3.9%. If only 50% of the fluorine released during production of phosphate fertilizers were recovered, it would equal 700 thousand tons/yr. Reserves of fluorine contained in phosphorites and apatites in different countries are listed; they equal 25,867,000 and 776,000 tons of phosphorite and fluorine, respectively. The waste gases of simple superphosphate production contain 15-30 g/cu m silicon tetrafluoride on the basis of fluorine. The parameters of the technological system of wet-process phosphoric acid production by the dihydrate method and the amount of of alkaline metals in the initial stock have a considerable effect on the distribution of fluorine in the production of superphosphate. The various phosphate and superphosphate producing processes are reviewed with respect to their production of fluorine. Possible means of increasing the degree of isolation of fluorine in the production of phosphate fertilizers include decreasing the losses in the production of fluorine salts from fluorine-containing solutions; development of effective methods of isolating fluorine from wet-process phosphoric acid; and intensifying the processes of absorption of fluorine-containing gases.

58879

Opie, W. R.

PROBLEMS IN SMELTING COPPER SCRAP. National Assoc. of Secondary Material Industries, Inc., New York, and Bureau of Mines, Washington, D. C., Eff. Technol. Res. Scrap Met. Recycling, Proc. Workshop, Washington, D. C., 1971, p. 52-54. (Jan. 7.)

In copper reclamation there are two grades of consumer-generated secondaries that are real metallurgical challenges-insulated wire and iron bearing material. With the first, the basic problem is how to handle the organic insulation. Burning it off is the preferred solution but this creates pollution problems. A universal solution is to design and operate a smelting unit which will use as much of the heat of combustion as possible to melt the copper, slag off some impurities, burn the resulting gases to completion in an afterburner, and scrub the products of combustion with a basic solution to neutralize the hydrochloric and hydrofluoric acids. A feasible approach to handling iron-bearing secondaries is to smelt them in a unit with suitable fume collection afterburning and gas scrubbing equipment. The fumes which come off blast furnaces and converters treating the smelter-grade copper scraps are essentially zinc oxides contaminated with large quantities of lead, tin, iron, chlorides, and fluorides. These products are caught in baghouses which are essentially for operating without polluting the atmosphere.

58993

Nix, Thomas B.

REMOVAL OF FLUORIDES FROM GASES. (Fuller Co., Catasauqua, Pa.) U. S. Pat. 3,790,143. 5p., Feb. 5, 1974. 1 ref. (Appl. July 31, 1972, 4 claims).

Methods and apparatus for removing gaseous fluorides from gases evolved from an aluminum smelting furnace are described. Basically, the fluorides are removed by achieving intimate contact between finely divided particles of alumina and the fluoride-containing gases. This is achieved by feeding the particles of alumina into a stream of gases collected from the aluminum smelting furnaces countercurrent to the flow of gases. The particles of alumina adsorb the fluorides. The particles of alumina and adsorbed fluorides are then separated in a gas-solids separator, such as a cyclone, and the alumina may then be fed to the smelting furnaces. Prefereably, two stages are used. The gases supplied to the second or last cyclone in the direction of gas flow are supplied with new alumina countercurrent to the flow of gases. The alumina particles removed in this second cyclone are conveyed to the gas stream supplied to the first cyclone in the direction of gas flow. In a two-stage apparatus, these gases will be those evolved from the smelting furnace or recirculated or a portion may be recirculated and a portion conveyed to the smelting furnace. The gases separated in the first cyclone are conveyed to the second cyclone. This method eliminates the necessity to cool the effluents as with a baghouse.

59230

Frasca, Ralph L.

HANDLING OF INSULATED COPPER WIRE SCRAP. National Assoc. of Secondary Material Industries, Inc., New York, Air Pollut. Control Technol., Proc. Workshop, Chicago, Ill., 1970, p. 107-116. (Oct. 22.)

Some of the basic problems encountered in the removal of insulation during the recovery of the conducting materials and the type of auxiliary equipment necessary to operate within air pollution control regulations are discussed. The most frequently used method is burning off. The insulations considered are polyethylene, polypropylene, polyvinyl chloride, teflon, nylon, neoprene, rubber and paper. Once ignited, polyethylene generates hydrocarbon gases which burn intensely. Burning under controlled conditions, only carbon dioxide and water vapor will be emitted. The necessary controls consist of a primary combustion chamber in which the burning rate is limited, and a secondary combustion chamber which is fired by auxiliary fuel and provided with overfired air. A high temperature secondary combustion chamber with sufficient air supply will completely burn the volatilized hydrocarbons giving a clean or steamy plume. The removal of polypropylene is like that of polyethylene. Facilities to handle polyvinyl chloride insulated wire should include a primary distillation chamber provided with a means of supplying the heat and temperatures necessary to start and continue at a reasonable rate the combustion of this flame retarding material, a secondary combustion chamber with an auxiliary fuel fire plus overfired air to complete the combustion of the carbonaceous materials, and a scrubbing unit to remove the hydrogen chloride fumes and metallic salts. Paper insulation on burns with too many problems of an air pollution nature. Fly ash is the biggest problem and this can be removed by a cyclone, electrostatic precipitator, or a wet scrubber. Processing of nylon insulation with primary and secondary combustion chambers will emit a gas containing mostly carbon dioxide and water. Since hydrogen chloride will be generated by burning neoprene, the gases must be passed through a scrubber. The burning of teflon releases hydrogen fluoride, and great care should be exercised.

59459

Singmaster and Breyer, New York

AIR POLLUTION CONTROL IN THE PRIMARY ALUMINUM INDUSTRY. VOLUME II OF II APPENDICES. National Air Pollution Control Administration Contract CPA 70-21, EPA-450/3-73-004b, 243p., July 23, 1973. 21 refs. NTIS: PB 224283/AS

The appendices of a detailed report on air pollution control in the primary aluminum industry are presented. They include: data acquisition questionnaire, particle size/weight distribution, fractional removal efficiency curves, sampling and analytical techniques, method 13-determination of total fluoride emissions, Environmental Protection Agency source sampling, emission flow diagrams, removal equipment purchase costs, and sample calculation of industry control improvement costs.

59679

Kobayashi, Hiroshi

DISPOSAL METHOD OF WASTE GAS CONTAINING HYDROFLUORIC ACID. (HF ganyu haigasu no shoriho). Text in Japanese. (Otomi Sangyo Co., Ltd., Osaka (Japan)) Japan. Pat. Sho 48-37662. 3p., Nov. 13, 1973. 4 refs. (Appl. June 3, 1966, 1 claim).

A method for the disposal of waste gas containing hydrofluoric acid produced during the manufacture of phosphate fertilizer and electrolytic manufacture of aluminum is presented. The waste gas containing HF is treated with an acidic solution containing alkaline salt to recover HF as acidic fluorides of alkali, which is neutralized by ammonia to produce both ammonium fluoride and alkali fluoride. The alkali fluoride so obtained is used for neutralizing the free acid formed in the process. The neutralization reproduces the alkaline salt which is recirculated for repeated use in the disposal process.

59845

Davids, P.

THE AIR POLLUTION PROBLEM HAS A SOLUTION. (Das Luftreinhalteproblem ist loesbar). Text in German. Umwelt (Duesseldorf), 4(1):26-27, 1974. 4 refs.

Measurements of the emissions from communal incinerators in the Federal Republic of Germany show that 3.9 kg hydrogen chloride kg trash, 0.033 hydrogen fluoride, 3.3 kg sulfur diox-

ide and 1.3 kg nitrogen oxides per ton of trash are emitted on the average. The contribution of incinerators to the total pollution is relatively low. Incinerators pose mainly a local pollution problem which can be rather easily solved because of the relatively high concentration of the pollutants in the waste gas. High collection efficiencies can be achieved with simple technical facilities. The removal of HCl and HF from waste gases is successfully applied in a number of processes. Even behind incinerators, scrubbers have been successfully used. Although these scrubbers have been primarily used for dust collection, every expert knows that simultaneously a high collection efficiency for HCl and HF is achieved. Calculations of the investment and operating costs of scrubbers are given.

59861

West, Norman Eugene

REMOVAL OF HF FROM AN HF-CONTAINING GAS. (du Pont de Nemours (E. I.) and Co., Wilmington, Del.) U. S. Pat. 3,743,704. 2p., July 3, 1973. 4 refs. (Appl. May 12, 1971, 4 claims).

A process for removing hydrogen fluoride from an HF-containing gas by scrubbing is described. The gas is scrubbed with water so that the HF enters the aqueous phase to form hydrofluoric acid, and the gas phase is vented as virtually HF-free gas. Precipitation of the fluoride ion in the aqueous solution as calcium fluoride is carried out by adding calcium hydroxide, calcium carbonate, or a mixture to the solution. Settling of the precipitate is improved by adding calcium sulfate to the aqueous solution during the reaction forming the precipitate. The precipitate is readily filterable. The aqueous phase which remains is virtually free of HF and can be used for scrubbing the HF-containing gas. The neutralization reaction which accompanies addition of Ca(OH)2 or CaCO3 to the aqueous solution can be carried out in two steps, first to partially neutralize the solution, e.g., pH up to six so that the solution is still able to be pumped to a settling tank, and second to complete neutralization in the settling tank. The CaSO4 addition can be postponed until the addition of Ca(OH)2, CaCO3, or their mixture to the settling tank. (Author abstract modified)

60075

Kawaraya, Toshiya

THE TECHNIQUES OF TREATING THE AIR POLLUTING POISONOUS SUBSTANCES. (Taiki osen kankei yugai busshitsu shori gijutsu). Text in Japanese. Seikatsu Eisei (J. Urban Living Health Assoc.), 17(4):133-143, April 1973. 5 refs.

Poisonous gases are eliminated by a wet gas absorption process. The main role of the equipment used for this is to increase the contact area between the gas and liquid as much as possible by dispersing the gas through the liquid. This can be done by a packed tower (PT), spray tower (ST), cyclone scrubber (CS), venturi scrubber (VS), jet scrubber (JS), wetted wall tower (WWT), and gas bubble column. Hydrogen fluoride and silicon fluoride can be eliminated by dissolving them in water using ST, PT, VS, or JT. The HF is collected by treating the solution with calcium hydroxide or sodium nitrate, or by absorption on calcium oxide. Fluorine should be dissolved in 5 to 10% sodium hydroxide. Chlorine can be eliminated by washing with water or alkaline solution, or by adsorption. The WWT is used when the concentration of poisonous gas is high, and PT or ST when it is low.

60206

Fish, William M.

ANTI-POLLUTION METHOD. (Aluminum Co. of America, Pittsburgh, Pa.) U. S. Pat. 3,760,565. 4p., Sept. 25, 1973. 4 refs. (Appl. July 19, 1971, 7 claims).

Removal of fluoride from a stream of gas contaminated with fluoride is described. Fluoride is adsorbed on alumina moving in the same direction and in contact therewith for not exceeding 20 sec. This method can be used to remove fluorides such as hydrogen fluoride from various off gases such as off gas from electrolytic cells used in production of aluminum by electrolysis of alumina. This invention is less costly and more efficient than previous methods using static and fluidized beds of alumina, since it requires a shorter contact time between alumina and fluoride. Alumina used in removal of fluoride from off gas from electrolytic production of aluminum can be used as alumina to be electrolyzed in one or more cells, resulting in a highly economical use of alumina. (Author abstract modified)

60255

Horikoshi, Takehisa

FLUE GAS DESULFURIZATION FACILITIES FOR SMALL BOILERS AND A GAS WASHING EQUIPMENT. (Kogata boirayo haien datsuryu sochi to mezurato gasu senjo sochi). Text in Japanese. Boira Gishi (Boilermen), 29(1):10-15, Jan. 1974.

The stack gas desulfurization facilities for small boilers, developed by Ebara Manufacturing Co., are described. Sulfur dioxide produced by the burning of heavy oil is dissolved in caustic soda to form sodium sulfite, which is, in turn, converted into sodium sulfate by special oxidation equipment and the caustic soda absorption liquid recycled. The facilities are characterized by high efficiency, low pressure loss, low power consumption, simplicity and compactness of design, easy maintenance, good adaptability to variation in gas volume, and the prevention of white smoke by a white smoke remover. Also described is the Ebara mesh plate tower gas washing facility designed to remove fluorine gas and dust from aluminum electrolysis factories.

60282

Haty, R. and K. S. Chari

POLLUTION AND ITS ABATEMENT IN FERTILISER INDUSTRY. Indian J. Environ. Health, 15(4):289-303, Oct. 1973. 42 refs.

Control methods for major air pollutants generated by fertilizer manufacturing operations are reviewed. Pollutants of significant concern include: dust, sulfur oxides, nitrogen oxides, fluorides, and ammonia. Abatement methods outlined include: collectors, wet scrubbing methods, electrostatic precipitation, various filter devices, dry absorption and adsorption processes, chemical and catalytic reduction, catalytic oxidation, combustion techniques, and by-product recovery. Major effects on the environment and human health are also tabulated for are also tabulated for each pollutant considered.

60849

Ministry of Labor, Health, and Welfare of North Rhine-Westphalia (West Germany)

ENERGY GENERATION. (Energieerzeugung). Text in German. In: Reine Luft fuer morgen. Utopie oder Wirklichkeit? Ein Konzept fuer das Nordrhein-Westfalen bis 1980. p. 40-51, 1972.

The state of the art and the evolution expected until 1985 in particulate matter, sulfur dioxide, nitrogen oxides, and gaseous

fluoride emissions from energy generation processes in power plants and in industries in North Rhine-Westphalia are outlined. Reduction of coal consumption, and increase in both fuel oil and natural gas consumption in both power plants and industrial power plants are expected during the period ending 1985. Accordingly, increases in the particulate matter, SO2, NOx, and F emissions would be unavoidable without further emission control measures. The installation of automatic recording instruments for the control of the combustion equipment alone would result in a decrease of about 50% in the dust emissions. Limitation of the dust emissions to 150 mg/N cu m in pit coal firings, to 100 mg/N cu m in brown coal firings, and to 0.6 kg/ton of heavy fuel oil by means of centrifugal dust separators would result in a decrease by 76% in the particulate matter emissions. Further decrease would be possible by increasing the efficiency of the dust separators in coal-firing equipment, and thereby limiting the dust emissions from pit coal firings and brown coal firings to 100 mg/N cu m and to 50 mg/N cu m, respectively. The flue gas desulfurization and coal desulfurization efficiencies are expected to reach 80% and 30%, respectively, and desulfurization of heavy fuel oil to 1% is anticipated. Heavy fuel oil with over 1% sulfur should be used in power plants with flue gas desulfurization, and industrial power plants should use fuel oils with less than 1% S. The SO2 emissions could be decreased by 54% by the use of fuel oil with a maximum S content of 1%, and of desulfurized coal in power plants equipped with flue gas desulfurization facilities. Flue gas desulfurization would also result in a decrease in the fluoride emissions by about 48%.

60864

Ministry of Labor, Health, and Welfare of North Rhine-Westphalia (West Germany)

CHEMICAL INDUSTRY. (Chimie). Text in German. In: Reine Luft fuer morgen. Utopie oder Wirklichkeit? Ein Konzept fuer das Nordrhein-Westfalen bis 1980. p. 14-26, 1972.

The state of the art and the expected evolution of air pollutant emissions in different branches of the chemical industry in North Rhine-Westphalia are outlined. The output of the chemical industry is predicted to rise by 320% by 1985, and new products will also cause new emission problems. The increase in the output will be highest in the most emission-intensive branches, e.g., plastic materials, synthetic fibers, and other organic materials. Organic gases and vapors, such as aldehydes, ketones, carbonic acids, organic sulfur and nitrogen compounds, hydrogen sulfide, sulfur dioxide, hydrochloric acid, fluorine compounds, carbides, arsenic, asbestos, and dusts of ferroalloys are the basic pollutants emitted by chemical plants. Since the emissions from synthetic fiber manufacturing plants would increase by 420% by 1985, all new plants to be put into operation in 1973 or later will have to be equipped with adequate emission control equipment for an emission abatement of 80%, and a similar reduction will be required for old plants from 1978. The same degree of emission abatement will be required for all new and old production plants in the pesticide manufacturing area from 1973. The SO2 emissions from sulfuric acid production can be lowered by 85% by the introduction of the Bayer double-contact process. The nitrous gas emissions from nitric acid production can be abated by 88% by catalytic reduction by means of natural gas or hydrogen. Abandonment of open-air operations, leakage control, automatic control of chemical processes, total, multistage or combined purification of malodorous and toxic emissions, and the use of recording analytical instruments are the basic possibilities of emission abatement in the chemical industry as a whole.

61259

Davids, Peter, Kurt Gerhards and Werner Brocke

THE PRESENT AND FUTURE AIR POLLUTION BY INCINERATORS - EMISSION AND REDUCTION OF EMISSIONS. (Die derzeitige und zukuenftige Luftverunreinigung durch Muellverbrennungsanlagen - Emission und Emissionsverminderung). Text in German. Staub, Reinhaltung Luft, 33(12): 483-489, 1973. 43 refs.

Measurements carried out in many refuse incineration plants have shown that, by using high-quality dust separators (electrostatic precipitators) or by optimum firing, it is possible to reduce the emission of dust and of unburned organic gases to relatively satisfactory values. However, the emissions of inorganic gases such as hydrogen chloride, hydrogen fluoride, sulfur dioxide, and nitrogen oxides present problems. About one half of the present HCl emission is due to the burning of chlorinated plastics (PVC). A forecast made for 1980 shows that this emission will increase. At present, wet separation is used to remove HCl and HF from waste gas. Operating experience and possibilities of optimizing the method are discussed.

61273

Teller, Aaron J.

PROCESS FOR RECOVERING GASEOUS HF FROM GASEOUS EFFLUENTS. (Wellman-Lord, Inc., Lakeland, Fla.) U. S. Pat. 3,773,633. 7p., Nov. 20, 1973. 5 refs. (Appl. March 13, 1970, 23 claims).

A process is described for recovering hydrogen fluoride from gases by contacting the gases with alumina pretreated with sodium hydroxide, potasssium hydroxide, or their mixture. This process can be used to recover gaseous HF from the waste gases produced in the manufacture of aluminum by the electrolytic process. The recovered HF can be reused in the electrolytic process. In a modification of this invention, the gases can be scrubbed by inertial impaction to remove particulates before they are placed in contact with the pretreated alumina for HF removal. (Author abstract modified)

61741

(Inventor not given.)

METHOD AND APPARATUS FOR CLEANING WASTE FLUE GASES. (Hitachi Co., Ltd., Tokyo (Japan)) Brit. Pat. 1,333,635. 6p., Oct. 10, 1973. (Appl. Nov. 16, 1971, 6 claims).

A method and apparatus for cleaning waste flue gases by removing such toxic gases as sulfur dioxide, nitrogen dioxide, nitric oxide, hydrogen sulfide, hydrogen fluoride, and fluorine is described. The method consists of spraying a reactant solution in the form of a fine mist into a hot waste flue gas, causing the toxic components contained in the waste flue gas to be absorbed by and react with the reactant solution. The water present in the droplets of the reactant solution is dried by the sensible heat of the waste flue gas and the reaction products are collected in the form of solid particles. The entire operation is carried out within a single spray drying tower in a short period of time in a manner to prevent a temperature lowering and humidity increase of the waste flue gas caused by the vaporization of the water contained in the sprayed reactant solution. The humidity of the flue gas released into the atmosphere is constantly maintained above the dew point to prevent the atmospheric pollution otherwise caused by the flue gas.

61935

Kanematsu, Sadao

AIR POLLUTION CONTROL IN GLASS INDUSTRY. (Garasu kogyo ni okeru taikiosen boshi taisaku). Text in Japanese. Seramikkusu (Ceramics), 9(1):49-55, Jan. 1974.

In the processes of glass production pollutants like sulfur oxides, nitrogen oxides, poisonous compounds, and dust are emitted. The allowable amounts of these products are regulated by laws issued by the central government or by contracts made between the local governments and the manufacturers. Sulfur oxides produced by combustion of heavy oil and pyrolysis of mirabilite are removed by wet desulfurization (Evergreen method) or dry desulfurization methods. In either case sulfur oxides are absorbed by sodium hydroxide solutions and oxidized by air, and then recovered as mirabilite. The desulfurization rate is better than 97% in the wet method and 80-90% in the dry method. In factories of the Asahi Co., Ltd., installations handling 370, 70, and 280 kcu m/hr of SOx-containing gas are operated. Fluorine compounds exhausted during glass production are handled by two methods. In the dry method fluorine reacts with lime or alumina and 99.5% of the fluorides are removed by a bag filter lowering the contents in exhaust gas to below 1 mg/Ncu m. In the wet method fluorides are absorbed by sodium hydroxide solutions to give a removal rate of better than 97% and a fluoride content of below 1 mg/Ncu m. No effective process has yet been obtained to remove nitrogen oxides, although concentrations in the exhaust gas from the melting furnace are from 310-1400 ppm. An electric melting method is now being investigated to solve pollution problems in the industry.

61954

Fuller, William Robert, Barrie Hill Bieler, and David Cecil Morgan

METHOD OF REDUCING HALIDE EMISSIONS FROM THE INCINERATION OF HALOGEN-CONTAINING PLASTICS. (Dow Chemical Co., Midland, Mich.) Brit. Pat. 1,325,460. 4p., Aug. 1, 1973. (Appl. Oct. 2, 1970, 10 claims).

A method of reducing halide emissions from the incineration of halogen containing plastics is described. The emissions can be substantially reduced by adding to the polymer a mineral alkali or alkali precursor before it is incinerated. It can be added to the waste in the form of an aqueous dispersion or of a particulate solid or powder. The suitable alkalis include hydroxides, oxides, carbonates, carboxylates, xanthates, sulfites, and hydrosulfites of the alkali and alkaline earth metals. Particularly good results can be obtained if a cellulosic waste (as paper) is also added and mixed with the halogen containing organic polymer waste before it is incinerated. The waste is preferably reduced to shredded or particulate form before it is incinerated. Advantageously the alkali or alkali-percursor is added to the shredded or particulate waste in an amount to provide 0.4 to 1 mole of alkali for each mole of halogen emission generated by the burning of the waste.

62165

Tsuritani, Taiichi

TECHNIQUE OF DISPOSAL OF DISCHARGED GASES. (Haigasu shori gijutsu. 1.). Text in Japanese. Selfuti Daijesuto (Safety [illegible], 19(9):351-363, Sept. 1973.

Waste [illegible] treatment and characteristics of poisonous gases and steams are discussed. For the treatment of stack gases, physical properties (such as boiling point, melting point, specific gravity, and vapor pressure), chemical properties (such as inflammability and explosiveness), and biological properties (such as toxicity) are important. Absorption, adsorption, combustion, and catalytic oxidation are used as control methods. Water and solutions of alkali in water are often used for the absorption of waste gases. Hydrogen chloride, hydrogen sulfide, and various acidic gases are effectively eliminated by this method. Active carbon is effective for the adsorption of nonpolar solvent vapors. Regeneration of active carbon is done with water vapor. Combustion is effective for organic gases, but this method cannot be used for waste gases containing sulfur compounds, sulfides, halogens, amines, and various nitrogen compounds because these appear as hazardous gases after combustion. Various data are given for chlorine, hydrocyanic acid, mercury, hydrofluoric acid, hydrogen sulfide, ammonia, carbon monoxide, hydrochloric acid, sulfur dioxide, ethylene cyanide, phenol, carbonyl chloride, formaldehyde, CH2CHCH, and toluene diisocyanate and other lesser compounds.

62786

(Inventor not given.)

REMOVAL OF HF FROM AN HF-CONTAINING GAS. (Du Pont (E.I.) de Nemours, Wilmington, Del.)) Brit. Pat. 1,342,703. 3p., Jan. 3, 1974. (Appl. May 12, 1972, 10 claims).

A process for the removal of hydrogen fluoride from an HF-containing gas is described. The HF-containing gas is contacted with water to form an aqueous HF solution. The solution is neutralized with calcium hydroxide, calcium carbonate, or mixtures of them in the presence of calcium sulfate. The presence of CaSO4 is an improvement over other systems using Ca(OH)2 because the sulfate alters the gelatinous nature of the precipitate to a form which settles more rapidly and which is more readily filterable from the aqueous solution.

63474

Mohanrao, C. J.

POLLUTION IN FERTILISER INDUSTRY. Fertiliser News., 18(11): 7-13,16, Nov. 1973. 10 refs.

The control of air pollutants from the fertilizer industry in India is discussed. The Indian Standards Institution is in the process of setting up air quality standards. The major pollutants are dust, sulfur and nitrogen oxides, fluorides, hydrogen sulfide, and ammonia. Commonly used dust control units include cyclone separator, wet scrubbers, bag filters, and electrostatic precipitators. The reduction of SOx in stack gas is accomplished by dry processes, wet processes, catalytic oxidation, and reduction. The NOx from the nitric acid and nitrophosphate plants are treated by absorption, adsorption, and catalytic reduction through the double combustion process or selective reaction process. The fluorine compounds are normally removed by wet scrubbing.

63540

Gottler, Hans

PURIFICATION OF WASTE GAS FROM GLASS POLISHING. (Verfahren zum Reinigen Abgesaugter Duempfe aus einer Saeurepolieranlage fuer Glasgegenstaende). Text in German. (Achthal-Maschinenbau-GmbH, Neukirchen (Germany)) W. Ger. Pat. Appl. 2,160,313. 4p., June 7, 1973. (2 claims).

Silicon tetrafluoride-containing vapors from an acid polishing plant for glass objects were purified by scrubbing with sulfuric acid which was subsequently recycled to the polishing bath.

63775

Huenlich, Hans-Werner

STATEMENT ON CURRENT PRACTICE FOR THE REDUCTION OF FLUORIDE EMISSION IN THE BRICK AND TILE INDUSTRIES BY SCRUBBING OF THE FLUE GASES. (Feststellung des Standes der Technik zur Verminderung der Fluoremission in der Ziegelindustrie durch Reinigung der Abgase). Text in German. Ziegelind. (Weisbaden), no. 4:155-162, 1974.

A state-of-the-art report on the separation of fluorine and sulfur oxides in the brick and tile industry is presented. The sulfur oxides and fluorides generated in firing processes in the ceramic industry are due to the inherent sulfur and fluorine contents of the fuels and raw materials, respectively, which make neutralization and separation of the pollutants the only possible solution. Sulfur dioxide, sulfur trioxide, and gaseous fluorides present in the flue gases in firing processes can be adsorbed and neutralized to form solid particles by dry and wet methods, especially by the injection of lime with subsequent dust separation by means of bag filters or electrostatic precipitators. While the dry processes have increasingly replaced the wet ones, scrubbing with lye solution is especially suitable for the joint removal of sulfur oxides and fluorine.

63784

Muhlrad, Wolf

ADSORPTION OF FLUORINE AND FLUORINE COMPOUNDS ON ALUMINA. (Air Industrie, Courbevoie (France)) U. S. Pat. 3,780,497. 7p., Dec. 25, 1973. 3 refs. (Appl. Aug. 20, 1971, 10 claims).

A method is provided for adsorbing fluorine on particles of alumina, the fluorine being in the elemental state or in the form of gasous fluorine compounds, and for collecting any ultra-fine dust resulting for example from sublimation. The fumes charge with fluorine compounds are one of the most unpleasant sources of atmospheric pollution, and their removal upon leaving electrolytic baths is necessary. The adsorption of the fluorine compounds on powdered alumina mitigates atmospheric pollution. The alumina particles are introduced at the base of an adsorption column through which the stream of gas to be scrubbed flows, the column terminating in a separator where the particles charged with fluorine are recovered. The path of the exhaust gas is cyclone separator to cloth-filter separator to scrubber. The method is particularly suitable for scrubbing of gas from electrolytic baths in an aluminum-producing plant.

64070

Teller, Aaron Joseph

FILTER AND METHOD FOR LOWERING ACIDIC GAS DISCHARGE IN EXHAUST PROCESS GAS. (Verfahren und Filtervorrichtung zum Senken von Saeuregasausstroemungen in einem ausstroemenden Prozessgas). Text in German. (Teller Environmental Systems, Inc., New York) W. Ger. Pat. Appl. 2,251,031. 15p., May 10, 1973. (30 claims).

Hydrogen fluoride, hydrogen chloride, and chloride are removed from industrial spent gases from glass making and aluminum producing processes by passage through sieves of finely divided nephelite syenite ore or alumina activated with sodium hydroxide or sodium carbonate. The adsorbents are blown as a finely dispersed powder or sprayed in aqueous suspension onto a sacking cloth filter 11.15 sq m to a depth of 1.27 mm. The acidic gases may be passed through a similar bed of adsorbent. The process may be continuous or carried out batch-wise.

64092

Walthall, J. H.

COMPACT SCRUBBER LESSENS DUCTWORK. Chem. Process. (Chicago), vol. 28:93, Aug. 1965.

A fume control system was designed to draw air from a superphosphate-curing den and to scrub out varying amounts of fluoride which would minimize costly ductwork use in controlling the corrosive fluorides. The fluoride concentration ranged from 0 to 0.001 lbs/cu ft during a 24-hour cycle of operation. The volume handled was 12,500 cu ft/min of gas. A jet-venturi flame scrubber operating on a principle similar to a steam-jet ejector was selected as the control method. It used a water or aqueous solution and a spray nozzle. With a concentration of 0.001 lbs/cu ft fluoride, when the fluorine content of the scrubber liquor is limited to about 3000 ppm, removal efficiency was approximately 98%.

64428

Graetz, Reinhard

FLUORIDE IN CERAMIC MATERIALS AND FUELS - PROVISION OF MATERIALS FOR THE PREVENTION OF FLUORIDE EMISSION. PART I. (Fluor in keramischen Materialien und in Brennstoffen. Stoffliche Massnahmen zur Vermeidung von Fluor-Emissionen (Teil I)). Text in German. Ziegelind. (Wiesbaden), no. 4:164-168, 1974. 27 refs. BSTRACT

The general problem of fluoride emissions, and the possibility of reduction of fluoride emissions in the stone and earth industry by the use of clays and fuels with low fluorine contents, and by stabilizing fluorine during the burning process, are described. Flue gas scrubbing for fluorine removal is not practical in the stone and earth industry due to the prohibitively high costs involved. During the burning process, gaseous fluorine emission should be prevented. Clays contain 0.01-0.1 weight percent fluorine, of which less than 20% are emitted in the flue gases.

64506

Bohm, Eberhard, Lothar Reh, Ernst Weckesser, Gunter Wilde, and Gunter Winkhaus

PROCESS FOR REMOVING HYDROGEN FLUORIDE FROM GASES CONTAINING IT. (Metallgesellschaft Aktiengesellschaft, Reuterweg (Germany) and Vereinigte Aluminiumwerke Aktien-Gesellschaft, Gerichtsweg (Germany)) Brit. Pat. 1,341,313. 8p., Dec. 19, 1973. (Appl. Nov. 12, 1971, 7 claims).

An adsorption process for removing hydrogen fluoride from gases in electrolytic aluminum recovery plants is described which allows good absorption at relatively high gas throughputs as compared to prior art adsorption processes. The gases which contain HF are injected as a fluidizing gas into a fluidized bed reactor containing a solid adsorbent for the HF at such velocity that they cause the solids to form an expanded fluidized bed in which the solids concentration decreases upwardly and from which solids containing adsorbed HF are discharged in an upward direction due to the velocity of the gases. The solids are thereafter separated from the gases. A preferred embodiment of the process involves supplying fresh solid adsorbent continuously to the fluidized bed, with HF-containing solid adsorbent being continuously removed from the bed.

64696

Kisters, Th. and H. H. Hebbel

LIMITING EMISSION IN CONNECTION WITH WASTE INCINERATING PLANTS: EXPERIENCE GAINED WITH A PILOT PLANT FOR THE DISPOSAL OF NOXIOUS GASES.

(Emissionsbegrenzung an Abfallverbrennungsanlagen - Erfahrungen mit einer Pilotanlage fuer die Schadgasbeseitigung). Text in German. Aufbereitung Technik, 15(5):229-233, 1974.

A gas scrubber pilot plant was installed in the incinerator operated by the city of Duesseldorf. The plant should help to determine the efficiency of the scrubbing method concerning elimination of hydrogen chloride, hydrogen fluoride and sulfur dioxide. Of these pollutants, the following weight fractions per cubic meter are measured in the flue gases from incinerators: up to 2000 mg hydrochloric acid, up to 1000 mg sulfur dioxide, 20 mg hydrogen fluoride and 400 to 500 mg nitrogen oxides. The flue gases which come from the electrostatic precipitator with a temperature of 280 C are cooled to 75 to 80 C and passed through a venturi scrubber and a droplet separator. The results indicate an increase of the HCl collection efficiency with increasing water quantity. At a stepwise artificial increase of the HCl concentration in the uncleaned gas to 5 g/cu m the HCl concentration in the cleaned gas rose as anticipated but the collection efficiency improved too. The collection efficiency for SO2 too depended on the water quantity and on the pH value of the scrubbing water. The residence time in the scrubber was too short to obtain any higher collection efficiency than 60 percent. Through installation of a second scrubbing stage an essential improvement of the SO2 collection efficiency was achieved. Experiments are still in progress so that no final results can be given.

64898

Nerihaya, Fumio and Tsugita Yukitake

EXHAUST GAS CLEANSING METHOD AND DEVICE. (Hai gasu joka hoho oyobi shochi). Text in Japanese. (Hitachi Co. (Japan)) Japan. Pat. Sho 49-24342. 5p., June 21, 1974. (Appl. Dec. 4, 1970, 2 claims).

A cleansing method and device for exhaust gas containing sulfur dioxide, nitrogen dioxide, nitric oxide, hydrogen sulfide, sulfur, hydrogen fluoride, and fluorine based on the chemical reaction with substances such as sodium hydroxide are described. In the vaporization tower, the exhaust gas is mixed with a spray mist of reaction solution, the toxic gases absorbed into the reaction solution undergo reactions, and the reaction products are solidified by the evaporation of water with heat retained in exhaust gas and recovered as solid particles. In the device of this invention, the vaporization tower with exhaust gas inlet located at the top and outlet located on the lower side wall is equipped with spray nozzles for supplying reaction solution mist located at the upper part of the tower. The detector device for measuring the toxic gas concentrations at the inlet of the tower and the supply system of reaction solution, in which the ratio of water and reactant is adjusted depending on the toxic gas concentration by means of the electrical signal from the detector, are connected to the vaporization tower. The supply of reaction solution is regulated so that the temperature in the vaporization tower would be maintained above the dew point by monitoring the temperature and humidity at the exhaust gas outlet of the tower. The exhaust gas containing solidified reaction products is led into a cyclone, separated, and recovered. A part of the solidified reaction product is led out of the tower through the outlet pipe with rotary valve or double air lock damper located at the bottom of the tower.

64977

Tatsumi Toshio and Ren Yasuda

RECOVERY OF FLUORIDES AND THEIR REUSE IN THE ALUMINUM REFINING INDUSTRY--CONSTRUCTION OF AN ALCOA DRY SCRUBBER. (Aruminium seiren kogyo ni okeru fukkabutsu no kaishu to sono sairiyo--Arukoashiki doraisukuraba no kensetsu). Text in Japanese. Kagaku Kojo (Chem. Factory), 18(8):81-84, Aug. 1974.

A dry scrubber for hydrogen fluoride recovery was discussed. Gases containing fluorides from an electrolytic furnace are introduced to the reactor where a flow bed is formed and HF is absorbed on alumina. Particles and dusts in the gas are collected with a bag filter above the flow bed and removed periodically. Clean gas which passes through the bag filter is released from the top of the reactor. Distribution of gas in the reactor is homogeneous and the area efficiencies which determine the reactor efficiency are high. The depth of the flow bed can be adjusted between 50 and 300 mm. The bag chamber above the flow bed comprises a row of bag filters and shaking rods. The total height of the bag chamber is 8 ft. Flue gases to the reactor were introduced from the main duct through a number of branch ducts designed to give an optimum operation cost.

65638

Droscha, Hellmut

HEAT AND ELECTRIC POWER FROM PRESSURE GASIFIED COAL. (Waerme und Strom aus druckvergaster Kohle). Text in German. Technica, 23(17):1403-1404, 1974.

An integrated coal pressure gasification and power generating pilot plant with a capacity of about 170 MW has been erected in Luenen, Westphalia, Federal Republic of Germany. A full-size plant is already under development. The main operating materials are coal, water, and air. The hot gas produced from coal first passes a scrubbing cooler and then drives with a pressure at 20 atm an auxiliary turbine which is succeeded by a compressor where preliminarily compressed air is further compressed to the pressure required for coal gasification. The gas, which now leaves the auxiliary turbine with a lower pressure, enters the combustion chamber of the steam boiler where it is burned together with compressed air at which process a high amount of heat is liberated. This is used for generation of high-pressure steam. At the same time the combustion gases drive the main gas turbine. The steam with a pressure of 130 atm and a temperature of 525 C drives the steam turbine of the system whose generator produces the main quantity of electric energy. The plant works with an efficiency of 43%. The pollutant emission is down to 1/4 of the emission of conventional plants. The dust and fluorine emission has been eliminated almost entirely, the emission of oxides of sulfur has been reduced by 90% and that of the oxides of nitrogen has been cut to 1/2.

65640

Kanematsu, Sadao

COUNTERMEASURES FOR PREVENTING AIR POLLUTION CAUSED BY GLASS INDUSTRY. (Garasu kogyo ni okeru taiki osen boshi taiseaku). Text in Japanese. Seramikkusu (Ceramics), 9(1):15-21, 1974.

Emission standards for general glass industries are: 1.0 mg/N cu m for cadmium and its compounds, 10 mg/N cu m for fluorides, and 20 mg/N cu m for lead and its compounds. The standards are much more stringent in Kaganaga prefecture, and are 0.5, 2.5 and 10, respectively. Emission standards for soot and dusts for glass industries are also stricter in Kanagawa prefecture than in other prefectures. Various control measures for air pollutants emitted by glass industries are discussed. For controlling sulfur oxides, the use of low sulfur fuels, high stacks, stack gas desulfurization systems are successfully employed. For dusts and soot, electrostatic precipita-

tors and filters can keep the emission concentrations to less than 0.05 g/N cu m. For toxic substances, more than 98% of lead and cadmium compounds can be eliminated by specially designed electrostatic precipitators. Fluorine, hydrogen fluoride, and silica fluoride are absorbed by powder absorbents such as slake lime and alumina, and filtered by glass fiber bag filter. The elimination rate exceeds 99.5%. The wet method of absorption utilizes caustic soda solution as absorbent. The process includes gas cooling, gas scrubbing and liquid waste treatment. The efficiency is more than 97% and the rate of dust collection is more than 75%. Fluorides in the stack gas are less than 1 mg/N cu m and soot is less than 0.05 g/N cu m. The emission standards for nitrogen oxides are expected to be set in 1974. Denitrization in glass industries is problematical. Glass melting furnaces cannot adopt systems such as flue gas recirculation or two-stage combustion. The only method presently being studied is an improvement in combustion methods. Unanswered questions include the acceleration of denitrization reaction speed, elimination of interfering substances in the gas, and the use and treatment method for by-products.

65923

FLUORINE RECOVERY BY THE PHOSPHATE FERTILIZER INDUSTRY PART II COMMERCIALLY AVAILABLE PROCESSES FOR RECOVERING FLUORIDES ETC. Phosphorus Potassium, no. 15:21-24, 28-29, July/Aug. 1971 4 refs.

Commercially available processes for the emission control of fluorine compounds in phosphate processing are discussed. In the past fluorine chemicals from phosphate plant off gases were scrubbed and disposed of, usually as fluosilicic acid. Today fluosilicic acid is the starting material for the production of a large range of fluorine compounds. The almost inexhaustible source of supply offered by recovery from phosphate processing has provided incentive for the development of a number of commercially feasible systems for the manufacture of materials as fluosilicates, fluorides, synthetic cryolite, and hydrofluoric acid from the fluorine effluent from phosphatic fertilizer production.

66592

Reither, K.

CLEAN AIR MAINTENANCE IN THE METALWORKING INDUSTRY. (Luftreinhaltung in der metallverarbeitenden Industrie). Text in German. Galvanotechnik, 65(7):628-630, 1974.

The principle and uses in the metalworking industry of KT model gas scrubbers are described. The gas scrubbers, of vertical or horizontal cylindrical design, have spray nozzles parallel with and opposite to the waste gas flow. They are available for throughputs of 36,000 and 280,000 cu m/hr. Higher capacity can be achieved by parallel connection of several units. The scrubbers are characterized by small pressure losses comprised between 15 and 70 mm water column for single-stage, and between 30 and 40 mm water column for two-stage designs. The hydrochloric acid-containing waste gases from a continuous wire pickling unit are scrubbed with water, and the dilute hydrochloric acid solution obtained in recycled within the pickling process. In two-stage operation, the HCl concentration is reduced from 3000 mg/cu m to 0.5 mg/cu m. In an electroplating shop, the vent air loaded with droplets and vapors of chromic acid from a chromium-plating bath is treated with KT model scrubbers, and the chromic acid recovered is recycled within the process. The chromic acid concentration in the air is reduced from 0.21 mg/cu m to 0.003 mg/cu m. The hydrofluoric acid-containing air in an eloxadizing shop is purified by KT scrubbers, using dilute sodium hydroxide solution as absorbent. Water is used for absorption of cyanides from the air in a hardening shop.

66618

Akulich, S. S.

ABSORBER FOR NEUTRALIZING ACID VAPORS GENERATED IN CHEMICAL POLISHING OF GLASS. (Absorber dlya neytralizatsii kislotnykh isparenly pri khimicheskoy polirovke stekla). Text in Russian. Steklo Keram. (Glass Ceram.), no. 7:37-38, 1974.

A two-stage foam type absorber for the absorption and neutralization of hydrofluoric acid vapors from the air in chemical glass polishing shops is described The air with the acid vapors is admitted at the bottom of a vertical plate column where a foam layer is formed over the plates for intensified contact between the wash liquid (water) and the air to be cleaned. The absorption efficiency amounts to 70-80%. If the residual HF output in the cleaned air exceeds 0.3 kg/hr further purification is done in a second stage at an efficiency of 91-96%.

66624

Kanematsu, Sado

THE PRESENT STATE AND FUTURE PROBLEMS FOR MAINTENANCE AND MANAGEMENT OF HIGH TEMPERATURE BAG FILTERS. (Koonyo baggu firuta no hoshu kauri no genjo to kongo no mondai). Text in Japanese. Preprint, Japanese Society for Chemical Engineering, p. 18-25, 1974. (Presented at the Symposium on Practical Problems in Factory Dust Collection Systems, Tokyo, Japan, July 5, 1974.)

A dry type bag filter for treatment of high temperature exhaust gas from a fiber glass plant is described. The exhaust gas contains fluorides, sulfur trioxide, soot, and other components. Exhaust gas is cooled from higher than 750 to 250 deg and powder absorbent is added. The resulting gas is then introduced to a bag house and dust is reduced to 0.001 gr/N cu m and fluoride to less than 2 ppm. Exhaust gas must be cooled to a temperature below the limit applicable to the filter cloth. An individual bag ranges from 130 mm in diameter, 3 m long, to 300 mm by 10 m. A reverse-pressure dumper is used to remove dusts on the filter bag. The suitable tensile strength of the bag is 15 kg for the small size and 35 kg for the large size. The future problems include improvement of mounting method of the bag, development of new bag cloths using special treating agents, and increasing velocity of filtering air. By increasing air velocity the scale can be reduced, thus the cost is minimized.

66947

Winkler, H. D.

MEASURES FOR REDUCING EMISSIONS FROM BRICK KILNS. (Massnahmen zur Emissionsminderung bei Ziegeleien). Text in German. Gesundh.-Ingr., 95(9):267-271, 1974. 8 refs. (Presented at the Second Symposium on Branch-Specific Emissions, Fluorine Emissions by Brick Kilns, Munich, Feb. 1, 1974.)

For the reduction of fluorine emissions from brick kilns in principle two different methods are applicable, chemisorption and absorption. The dry chemisorption process is in general preferred over of the wet absorption process because it avoids the waste water problem. With the injection of pulversized calcium hydroxide into the flue gas flow a direct reduction of the gaseous fluorine compounds as well as of the oxides of sulfur

can be achieved. A schematic diagram of the process is given. With this method clean gas concentrations of around 5 mg F/cu m could be achieved. Essential for a sufficient binding of the pollutants is a long residence time. Therefore the method is applicable only if the flue gas ducts are longer than 10 m. The particulate emission rises through the injection of pulverized calcium hydrate. A dust collector is therefore indispensable. The costs are lowest if a cyclone is installed for this purpose. Better results are achieved with a cloth filter, however. In the latter case the operating costs are as high as that of acid scrubbing. The dry system is in some plants presently in operation, however without dust collectors. Two plants in West Germany have been equipped with wet absorbers. For the collection of gaseous fluorine compounds, acid absorption with water and subsequent neutralization with lime-milk was found most suitable. Clean gas concentrations of less than 5 mg F/cu m were achieved with this method.

67136

English, M.

FLUORINE RECOVERY FROM PHOSPHATIC FERTILIZER MANUFACTURE. Chem. Process Eng., vol. 48:43-47, Dec. 1967. 12 refs.

The present demand for fluorine is expanding so rapidly that the traditional sources -- natural cryolite and fluorspar -- may soon be exhausted. An alternative source is fluorapatite, containing 3.5% fluorine, used principally for the production of superphosphate and phosphoric acid for fertilizers by the wet process. A process is described for using the by-product from the process, fluorosilicic acid, which is generally discarded, in the commercial production of fluorosilicates, cryolites, and fluorides. The fluorosilicic acid is produced during production of superphosphate and phosphoric acid when fluorine compounds in the stack gas are absorbed in a countercurrent scrubber. (Author abstract modified)

67137

ALUMINUM FLUORIDE FROM WET PROCESS PHOSPHORIC ACID WASTES. Brit. Chem. Eng. Proc. Tech., 17(7/8):609-610, July/Aug. 1972. 1 ref.

The wet phosphoric acid process evolves large quantities of fluorine compounds; upwards of 40-45 fluosilic acid kg/ton phosphoric anhydride emitted is recoverable. The present capacity of the fertilizer industry is enough to supply virtually the entire aluminum industry with the fluorine compounds it requires, particularly aluminum fluoride. A process capable of producing AlF3 from H2SiF6 solution arising from the scrubbing of the waste gases evolved in the production of phosphoric acid is described. Variable costs for this process are cited. An approximate estimate of the investment for a plant to produce 100 tons/day of AlF3 is $752,000. An analysis is presented of investment distribution by different sections of the process and by function.

67217

Morris, George O.

RECOVERY OF HYDROGEN FLUORIDE. (Imperial Chemical Industries, Ltd., London (England)) U. S. Pat. 3,798,875. 4p., March 26, 1974. 2 refs. (Appl. Feb. 22, 1972, 16 claims).

A process for the recovery of hydrogen fluoride from gaseous mixtures is presented which overcomes prior art problems associated with heat transfer and breakdown of solid absorbents by using the absorbing solid in an inert liquid. The gaseous mixture is passed through a suspension of an alkali-metal fluoride, preferably sodium fluoride, in an inert liquid having a boiling point of at least 250 C. The suspension is maintained at a temperature below 180 C and at a temperature at which the hydrogen fluoride is absorbed by the suspension. The suspension is heated to a temperature of greater than 180 C for liberation of the hydrogen fluoride, with the suspension then being regenerated. The process may be applied to the recovery of hydrogen fluoride from mixtures in which the hydrogen fluoride content varies as much as from 2-98% by weight.

67700

Puhr-Westerheide, H.

POWER PLANTS WITH COAL PRESSURE GASIFICATION. (Kraftwerke mit Kohledruckvergasung). Text in German. VGB Kraftwerkstechnik, 54(8):532-536, Aug. 1974.

For the first time in the Federal Republic of Germany the combined gas steam turbine process with preceding coal pressure gasification has been realized in the power plant Luenen. The gas from coal pressure gasification is burned in a steam generator at high overpressure. A gas turbine is installed in the flue gas path where the temperature is between 800 and 1000 C. The steam produced is used in a conventional steam turbine set. The compressor of the gas turbine set supplies the gasification and combustion air. The gas from coal gasification is cleaned in a scrubber system to remove dust and tar residues. Subsequently the sulfur content is reduced by 90%. The power plant produces 170 MW, 74 MW coming from the gas turbine and 96 MW from the steam turbine. The entire power plant has been in operation for 3000 hr. The operating experiences to date are described in detail. The gas cleaning system failed to reach the quaranteed efficiency. The tar separator is presently being modified and enlarged. The hydrogen sulfide from the desulfurization plant is processed in a Claus plant to obtain elemental sulfur. Despite the present shortcomings the dust emission is far lower than that of fossil fuel-fired power plants, the oxides of nitrogen emission is also far lower, and the desulfurization plant not only removes the sulfur dioxide content but also the fluorine content of flue gases.

67742

Statens Naturvardsverk, Stockholm (Sweden)

AIR AND WATER POLLUTION PROBLEM IN FERTILIZER PRODUCTION. (Vatten- och luftvardsproblem vid tillverkning av godselmedel). Text in Swedish. Rept. 1971:6, 120p., 1971. 8 refs.

The emissions and control of air pollutants from the fertilizer industry in Sweden are discussed. Atmospheric emissions for 1969-1970 in Landskrova totaled 100 kg/hr nitrogen compounds, 12 kg/hr fluorine compounds, 100 kg/hr sulfur dioxide, and 30 kg/hr of dust. In Koping the N2 emissions were 170 kg/hr, phosphorus 0.2 kg/hr, F2 410 kg/hr, and dust 70 kg/hr. Pollution control measures are practiced: ammonia and F2 are adsorbed, dust is removed with cyclones and filters, and residual gases containing F2, nitrous gases, and dust are removed by scrubbing. Fluorine can also be controlled by using evaporated phosphoric acid which has a flow F2 content. Some by-products are recovered as NH3 from a urea plant.

67846

Lihou, D. A.

FLUORINE COMPOUNDS AS BY-PRODUCTS OF PHOSPHORIC ACID MANUFACTURE. Chem. Process Eng., 1964:604-611, Nov. 1964. 21 refs.

Typical phosphate rock has a 3.5% fluorine content. During phosphoric acid production and concentration, a significant

amount of fluorine compounds are therefore liberated as air pollution f- generally as silicon fluoride, hydrogen fluoride, and fluorosilic acid. Various processes for the recovery of these compounds and their conversion into fluorosilicates, fluorides, cryolites, and fluoroborates are discussed. The growing importance of these compounds in all spheres of the economy is illustrated by a table of their applications. (Author abstract)

67954

Dobos, Gyorgy

ENVIRONMENTAL PROTECTION IN ALUMINA PROCESSING UNITS AND ALUMINUM PLANTS. (Kornyezetvedelem a timfoldgyarakban es aluminiumkohaszati uzemekben). Text in Hungarian. Musz. Tud., 46(3-4):363-378, 1973. 33 refs.

Environmental problems in alumina processing and aluminum melting plants are described. It is now possible to prevent dust emission by wet milling of bauxite in ball mills. The sulfur dioxide and alumina dust emissions generated during alumina calcination can be abated by the use of low-sulfur fuel, especially natural gas. Fluorine emissions, found to cause damage to forests and cattle around aluminum melting plants, can be abated by modern processes, such as the activated alumina process, filtration with alumina-coated bag filters, or flue gas scrubbing. The environmental nuisances due to red mud dumps, releasing alkaline dust steadily into the atmosphere can be best prevented by the complex utilization of this material for iron recovery, brick manufacture, or other purposes.

68201

Kelley, J. A.

DISPOSAL OF FLUORINE BY REACTION WITH CHARCOAL. Du Pont (E. I.) de Nemours and Co., Aiken, S. C., Savannah River Lab., Atomic Energy Commission Contract AT(07-2)-1, 15p., Aug. 1974. 7 refs. NTIS: DP-1359

Tests were made to determine the type of charcoal and operating parameters best suited for fluorine disposal. Nonactivated wood charcoal was safe in operation, and heating of the charcoal to approximately 300 C was necessary for efficient reaction of fluorine. At low fluorine concentrations (less than 25% fluorine in the gas stream), the principal reaction product is a white fluorocarbon smoke. Carbon tetrafluoride is the principal product with 100% fluorine. A small amount of condensable fluorocarbons is formed by the fluorine-charcoal reaction. (Author abstract)

68633

Isahaya, Fumio and Tugihiro Yukitake

PURIFYING EXHAUST GAS. (Verfahren und Vorrichtung zur Reinigung von Verbrennungsabgasen). Text in German. (Hitachi Ltd., Tokyo (Japan)) W. Ger. Pat. Appl. 2,159,186. 5p., June 15, 1972. 1 ref. (2 claims).

Toxic impurities such as sulfur dioxide, nitrogen dioxide, nitric oxide, hydrogen sulfide, hydrogen fluoride, or fluorine are removed from combustion gases in a scrubber or washing tower by sprayed-in reagent solution as a fine cloud according to the temperature of the gases and the concentration of impurities, such that the temperature of the gases leaving the tower is above the dew point, all the liquid in the tower is vaporized and the reaction products of the impurities are obtained at the towers outlet in solid form. The apparatus is described.

68795

Baurhenne, Georg

REMOVAL OF ACID COMPONENTS FROM REFUSE INCINERATOR. (Verfahren zur Reinigung von Abgasen aus Muellverbrennungsanlagen). Text in German. (BAMAG Verfahrenstechnik GmbH, Butzbach (Germany)) W. Ger. Pat. Appl. 2,139,678. 2p., Feb. 15, 1973. 2 refs. (1 claim).

A method for the removal of acid gases such as sulfur dioxide, sulfur trioxide, hydrogen chloride, hydrogen fluoride, and nitrogen dioxide from waste incinerator flue gases is described. The gas to be purified is passed through a loose layer of active carbon at a temperature that lies 30 C, and preferably 15 C, above the water-vapor dew point. In one example, when flue gas with 3000 ppm HCl, 1000 ppm SO2, 300 ppm SO3, 20 ppm H2F2, and 35 ppm NO2 was passed through a 1.5 m thick active carbon layer at a rate of 0.45 m/sec and at 85 C, the purified gas contained 3 ppm HCl, 10 ppm SO3, 1 ppm H2F2, and 5 ppm NO2. The activated carbon is regenerated by washing first with water, and then with dilute ammonia solution.

69131

Connor, J. M., G. J. Dell, and D. J. Newman

POLLUTION CONTROL IN ACID PLANTS. Chem. Age India, 23(2):103-117, 1972. (Presented at the UNIDO 2nd International Fertilizer Symposium, Viev, USSR and New Delhi, India, 1971.)

Pollution problems and emission control measures are reviewed for plants involved in the production of sulfuric acid, phosphoric acid, and nitric acid. Incomplete conversion of sulfur dioxide to the trioxide is the fundamental difficulty encountered in H2SO4 plants. The double absorption process appears to be the most successful on a commercial scale for minimizing sulfur dioxide emissions. Fluorides released during rock digestion and acid concentration are the main problems of phosphoric acid production. These emissions can be minimized by use of properly designed scrubbers and by product recovery techniques. Nitric acid plants discharge unabsorbed nitrogen oxides in the absence of control measures. These can be most economically eliminated by reaction with fuel in a catalytic combustor. Adsorption of NOx on silica gel or on molecular sieves is also feasible, though not economically competitive at present with catalytic combustion.

69191

Fukumori, Rokuro

HYDROGEN FLUORIDE ABSORPTION TREATMENT METHOD. (Fukka suiso no kyushu shoriho). Text in Japanese. (Asada Chemical Industry Co., Himeji (Japan)) Japan. Pat. Sho 49-38440. 3p., Oct. 17, 1974. (Appl. Oct. 27, 1969, 1 claim).

When aluminum is electrolyzed a large quantity of fluoride gas is emitted, and this gas is usually treated by aluminum sulfate solution absorbent. But the absorption process is slow and the high temperature tends to create hydrogen fluoride from the by-product sulfuric acid when the aluminum fluoride settles. This invention prevents the secondary emission of HF and also improves the absorption rate of HF by using a solution of basic aluminum (30-60% of basicity). The HF is reacted while boiling to 30-60% base aluminum and is precipitated in the form of aluminum fluoride or its hydrate. The method of calculating basicity from the concentration of aluminum oxide and chlorine ion is described along with several examples.

69528

Wolfrom, Walter, Walter Schultheis, and Wolfgang Koelling

PROCESS FOR THE ABSORPTION OF SIF4-CONTAINING OFF GASES IN WATER OR AQUEOUS HEXAFLUOSILICIC ACID. (Verfahren zur Absorption von SiF4-haltigen Abgasen in Wasser oder waessriger Hexafluorkieselsaeure). Text in German. (Assignee not given.) E. Ger. Pat. 88,078. 2p., Feb. 20, 1972. (Appl. Jan. 13, 1971, 2 claims).

A method for the absorption of silicon tetrafluoride-containing waste gases in water or aqueous hexafluosilicic acid to obtain commercial hexafluosilicic acid of at least 20% concentration is described. The silicon tetrafluoride is absorbed in two successive, slotted-bottom absorbers with a maximum temperature of the absorbing suspension on the first absorption stage of 50 to 60 C, corresponding to a desired hexafluosilicic acid concentration of 20-30% to prevent incrustation of the absorber bottom. Cooling of the SiF4-containing waste gas is achieved by dilution with cold air.

69965

Rinckhoff, J. B. and W. R. Parish

DOUBLE CATALYSIS SULFURIC ACID PLANTS FOR COPPER CONVERTER GAS. Preprint, American Inst. of Chemical Engineers, New York, 11p., 1974. (Presented at the American Institute of Chemical Engineers, National Meeting, 78th, Salt Lake City, Utah, Aug. 18-21, 1974.)

A double catalysis sulfuric acid plant for the conversion of sulfur dioxide in copper converter gas to H2SO4 is described which achieves SO2 emissions well below the 500 ppm level. As opposed to the conventional plant where the conversion of SO2 to suflur trioxide is carried out in three or four catalyst beds in series with cooling between the beds to remove the heat of reaction, the double contact catalysis plant removes a major portion of the SO3 in an intermediate absorption tower after the second stage of conversion. The balance of the gas, which is returned to the converter for the final two stages of conversion, is a very weak SO2 gas with a high oxygen/SO2 ratio. The equilibrium conditions for this gas leaving the converter are very close to 100% conversion of the total SO2 entering the converter. With steady state operation, which is not realized in practice, the overall conversion of SO2 to SO3 is greater than 99.8%. The presence of appreciable fluorine in the gas may require two scrubbing towers in series to achieve complete removal of the fluorine; this is primarily to protect the catalyst in the contact section of the acid plant. Sulfuric acid mist is removed in a purification section of the plant consisting of electrostatic mist precipitators.

70428

Mantle, E. C.

PREVENTION OF AIR POLLUTION IN THE NON-FERROUS METALS INDUSTRIES. BNF Metals Technology Center, Oxon (England), 207p., 1974. 132 refs.

Methods for the assessment, prevention, and control of air pollution from the non-ferrous metals industries (primary smelting of copper, lead, zinc, and aluminum; melting and casting of non-ferrous metals and their alloys; and secondary metallurgical operations) are reviewed. Pollutants associated with such operations include: sulfur dioxide and sulfur trioxide, fluorides, dusts containing metals, metal oxide fumes, and solvent vapors. Prevention and control measures include: pretreatment of materials, fume containment and ducting, reduction of pollution by dispersal (stacks), and various collection methods. Principles of collection are discussed in terms of settling chambers, cyclone collectors, wet scrubbers, filters, and electrostatic precipitators. Sampling and monitoring requirements are reviewed in terms of techniques applicable to measurements in ducts or stacks, indoor atmospheric measurements, and outdoor ambient measurements. Threshold limit values for substances in workroom air (American Conference of Governmental Industrial Hygienists, 1972) are also reviewed in an appendix.

70537

Radke, D.

DRY CLEANING PROCESSES FOR WASTE GASES FOR SEPARATION OF DUSTS AND HYDROGEN FLUORIDE. (Trockenreinigungsverfahren fuer Abgase zur Abscheidung von Staeuben). Text in German. Tech. Mitt., 67(11):484-489, 1974. 6 refs. (Presented at the Seminar on Dust Collection in Industrial and Commercial Plants, Haus der Technik, Essen, West Germany, May 15, 1974.)

A dry method for the separation of hydrogen fluoride is described. Quicklime is agitated as separating agent in funnel-shaped reactors, reducing the hydrogen fluoride concentration to less than 1 mg/cu m waste gas. With the same method, hydrogen chloride could be separated on laboratory scale if quicklime dust was added to an oxygen lancing plant. The equipment comprises a radial ventilator, two reactors, one cyclone, one bag filter, and accessories such armatures, pipes lime storage and a feeder. The waste gas is pressed by the ventilator through two successive reactors where reaction of the fluorine with the agitated quicklime takes place and calcium fluoride is formed. The solid matter carried off with the waste gas from the second reactor is separated first in a cyclone and then in a cloth filter.

70658

Nakaya, T., K. Yoshimura, and M. Takahashi

TREATMENT OF DUST FROM METAL MELTING FURNACE (NONFERROUS METAL). (Kinzoku yokairo (hitetsu kinzoku) no baijin shori ni tsuite). Text in Japanese. Taiki Osen Kenkyu (J. Japan. Soc. Air Pollution), 9(2):429, Nov. 1974. (Presented at the National Air Pollution Research Conference, 15th, Chiba, Japan, Nov. 6-8, 1974, Paper 250.)

Results of an investigation on 217 facilities for metal processing in Osaka Prefecture (excluding Osaka city) are given. The facilities included 50 reverberatory furnaces, 148 crucible furnaces, and 19 low-frequency induction furnaces. Furnaces used to regenerate Al emitted Al metal fumes, chlorine, and fluorine, whereas those used for alloy manufacturing emitted metal fumes and sulfur dioxide. For the removal of metal fumes, bag filters were employed, and for the removal of metal fume accompanied with gaseous substances, a bag filter together with a scrubber was used. Results of measurement at a manufacturing plant showed that the combination of a bag filter and a scrubber reduced particulates from 0.11 g/N cu m to 0.04 g/N cu m, Cl2 from 1896 ppm to 15 ppm, and HCl from 2000 ppm to 50 ppm.

70659

Yamashita, Hachiro and Yasuo Kobayashi

FURNACE GAS COLLECTION METHOD IN ALUMINUM ELECTROLYSIS BATH. (Aruminyumu denkaiso ni okeru rogasu saishu hoho). Text in Japanese. (Mitsubishi Kasei Kogyo Co., Ltd., Tokyo (Japan)) Japan. Pat. Sho 49-43046. 3p., Nov. 19, 1974. 1 ref. (Appl. April 14, 1970, 1 claim).

The use of a gas curtain for collecting furnace gas containing toxic fluorine compounds and carbon monoxide from an aluminum electrolytic furnace is described. Between the side cas-

ing of the vertical anode and side insulator for the horizontal carbon cathode, a gas curtain is created diagonally covering the area from the side insulator of the carbon cathode, crust, and skirt of vertical casing wall for the anode and part of the vertical casing wall. A gas injection port may be located on the vertical casing wall and gas suction port on the insulator, or vice versa. The furnace gas trapped by the gas curtain is led to a gas cleansing device by suitable means, thus preventing the discharge of toxic furnace gas into the furnace room.

70840

Mehta, Prakash

CRITERIA FOR DESIGN AND SELECTION OF AIR POLLUTION CONTROL SYSTEMS. Central Labour Inst., Bombay (India), Proc. Semin. Air Pollut. Control Tech., India, 1973, p. 111-118. (Sept. 11-12.)

Guidelines are given for the control and dispersion of gaseous and particulate air pollutants commonly emitted by the fertilizer industry. Pollutants most frequently associated with chemical operations in fertilizer manufacturing include: sulfur oxides, carbon monoxide and dioxide, nitrogen oxides, ammonia, fluorides, and particulates. Gaseous pollutants can be removed from air streams by condensation, scrubbing, adsorption, or incineration. Vapors present in high concentration and at dew-point temperatures greater than 90 F can be removed by condensation (direct cooling or compression). Scrubbing can be used to remove pollutants at concentrations greater than 1% and soluble in water. Pollutants with molecular weights greater than the normal components of air can be removed by adsorption. Combustible vapors can be burnt in direct or catalytic units. Mists less than 10 micron and at low concentrations can be removed with electrostatic precipitators, scrubbers, high-density fibrous filters, or packed beds; while sprays greater than 10 micron in size and in concentrations greater than 1 grain/cu ft can be removed with inertia separators, coarse fibrous filters, or packed beds. Submicron particles (fumes can be cleaned from exhausts with high-energy wet collectors, electrostatic precipitators, or bag filters. Dusts between 1-10 micron can be removed with wet collectors and mechanical or inertia separators, whereas dusts greater than 10 micron can be cleaned from exhausts with settling chambers or cyclones. Effective dispersion of the final exhaust requires a stack height of at least two times the height of any surrounding obstacle. The stack should be designed to ensure that gases will escape the turbulent wake of the stack.

71297

Steineke, Fredrik

METHOD OF RECOVERING FLUORINE FROM WASTE GASES. (Elkem- Spigerverket A.S., Oslo (Norway)) U. S. Pat. 3,812,852. 3p., June 4, 1974. 3 refs. (Appl. March 19, 1973, 8 claims).

A method for the economical adsorptive recovery of fluorine components from high temperature (500 C) gas streams is described that utilizes steam to increase the amount of fluorine chemically bound to an aluminum oxide adsorbent. The amount of steam added to the dry gas stream must be at least 0.5% by volume of the waste gases and is generally not more than 25% by volume. The steam can be added directly to the waste gases as a separate stream or it can be added to the waste gases in a fluidized bed reactor. Alternatively, the dry fluorine-containing gases can be mixed with gases having moist fluorine. The contact between the gas stream and the aluminum oxide adsorbent occurs at temperatures above the boiling point of the water in the particular contacting environment and below temperatures at which fluorine adsorbed by the aluminum oxide is liberated during the contact period.

71412

Shimoi, Yoichi, Masayuki Kiuchi, and Yutaka Takeda

TURRET---ACIDIC GAS ABSORPTION BY WATER. (Teraretto---Mizu ni yoru sansei gasu no kyushu). Text in Japanese. Kagaku Kojo (Chem. Factory), 18(11):49-55, Nov. 1974. 16 refs.

The of acidic gas by water is one of the most basic forms of gas absorption, and can be handled by physical absorption theory. Some calculation examples made to obtain data for designing a packed tower using S and L type turrets for the absorption of sulfur dioxide, hydrogen chloride, hydrogen cyanide, and hydrogen fluoride by water are shown. In an SO2-air- H2O system, the Whitney s equation constant, liquid-gas equilibrium and turret pressure loss under a given set of conditions were calculated. In the case of HCl-air-H2O system, the calculations for tower diameter, packed tower height, and pressure loss to attain certain absorption rates are shown. In the case of phosphorus ore treatment as an example of the the HF-air-H20 system, the silicon tetrafluoride partial pressure over hydrofluosilicic acid solution, H2F2-SiF4-H2O phase composition and HF-H2O equilibrium were calculated. Similar calculations were also made for an HCN-air-H2O system. The effects of fume on absorption, particularly in the case of acidic gases such as sulfur trioxide, HCl, and chloric acid are discussed.

71472

Tatsutani, Bunkichi, Akiharu Muranushi, and Katsuhiko Yamamoto

TREATMENT METHOD OF GASES CONTAINING HYDROGEN FLUORIDE AND SULFUR DIOXIDE. (Fukka suiso to nisanka iou konyu gasu no shori hoho). Text in Japanese. (Denki Kagaku Kogyo Co. Ltd., Tokyo (Japan)) Japan. Pat. Sho 49-47629. 4p., Dec. 17, 1974. (Appl. Feb. 7, 1970, 1 claim).

An invention for the selective recovery of hydrogen fluoride and sulfur dioxide from waste gas emitted from phosphate fertilizer manufacturing processes is described. Waste gas containing 6.5 wt% water, 3100 ppm HF and 1600 ppm SO2 at 280 deg is introduced into a cooling tower at 670 N cu m/hr. Hydrogen fluoride solution (9.4 wt%) at 60 deg and water at 25 deg were sprayed from the top of the cooling tower at a rate of 700 l/hr and 63 l/hr, respectively. The resulting gas containing 15.9 wt% H2O at 60 deg is led to a gas absorbing tower to which water is supplied at 100 l/hr. Liquid containing 1.6 wt% HF and 0.005 wt% SO2 at 58 deg is released from the bottom of the tower while gas is introduced to a desulfurization tower to which sodium hydroxide solution is supplied. The resulting gas contains no detectable HF and 11 ppm SO2.

71623

Glowiak, Bohdan and Adam Gostomczyk

STUDIES CONCERNING THE SORPTION OF FLUORINE COMPOUNDS ON ION EXCHANGERS. (Untersuchungen ueber die Sorption von Fluorverbindungen auf Ionenaustauschern). Text in German. Staub, Reinhaltung Luft, 34(12):442-445, 1974. 9 refs.

After successful laboratory experiments with anionic ion exchangers concerning sorption of hydrogen fluoride, experiments were carried out in a hydrofluoric acid production plant. The plant emitted 600 cu m waste gas/hr containing .0002-.0006 kg HF/cu m. Through the experimental set-up 300 cu m gas/hr were drawn. The waste gas entered the column which was equipped with two polyethylene grids with an average mesh width of 3mm. The grids carried two layers of anionic ion exchanger with a granulation of 4 to 6mm. The anionic ion

exchanger was sprayed with a 4% NaOH solution. The method is suitable for use as a third cleaning stage succeeding the sorption of HF and silicon tetrafluoride in water and in an aqueous Fluosilicic acid solution, cleaning the gases to a residual HF concentration of .00001 kg/cu m.

71796

Horvath, Zoltan and Jozsef Weber

ENVIRONMENTAL PROTECTION IN ALUMINUM INDUSTRY. (Kornyezetvedelem az aluminiumkohaszatban). Text in Hungarian. Banyasz. Kohasz. Lapok - Kohaszat, 107(9):399-404, 1974. 7 refs.

Emission sources in the aluminum industry, and possibilities of air pollution abatement are described. Red mud dumps, when dried out, represent a major source of alkaline dust emissions. Calcining plant waste gases, containing sulfur dioxide, carbon monoxide, and red mud particles are cleaned in a system composed of a dust chamber, multicyclone, and electrostatic precipitator. The flue gas SO2 content can be abated by the use of natural gas or low-sulfur fuel oil and by combustion air preheat. The fluorine, tar, and carbon monoxide emissions from electrolyzers can be abated by the adoption of closed-cycle technology, and wet or dry gas cleaning. In wet gas cleaning, the carbon, tar, and carbon monoxide present in the waste gases are incinerated, after which most of the soot and dust are separated in a cyclone. Further cleaning is done in an electrostatic precipitator and wet scrubber. Scrubbing can be done with water, or by acid and alkaline solutions used consecutively. Dry gas cleaning by means of alumina fluidized beds and bag filters reaches efficiencies of 99.9%.

71841

(Inventor not given.)

POLLUTANT COLLECTION BY IRRADIATION. (Environmental Master Systems, Inc., Canfield, Ohio) Brit. Pat. 1,360,402. 9p., July 17, 1974. (Appl. Oct. 26, 1971, 21 claims).

An irradiation method for the collection of particulate and gaseous pollutants (e.g., sulfur dioxide, nitrogen oxides, carbon monoxide, hydrocarbons, hydrogen fluoride, and hydrogen chloride) from coal-burning and various industrial processes is described that achieves such collection without the undue cost or complexity of prior-art methods. The pollutants are ionized with isotopic irradiation, thereby inducing conglomeration for subsequent collection. The apparatus for removing the pollutants includes a passageway with an inlet and outlet, a means to convey the effluent gases into the passageway inlet, an irradiation zone containing a high energy, high intensity isotope source (cobalt 60) positioned between the ends of the passageway, and a collecting means joined to the outlet passageway outlet to receive the irradiated pollutants. The isotope source is capable of creating a radiation field at energy levels of at least one million electron volts and exposing the pollutants to dosage levels of at least one kilorad.

72038

Aso

A UNIT CAPABLE OF ELIMINATION OF FLUORINE AND SULFUR FROM EXHAUST GAS. (Haien datsu fusso datsuryu sochi). Text in Japanese. Mitsubishi Jushi Giho (Mitsubishi Plast. Tech. Rev.), no. 8:78-80, Aug. 1974.

Japan Selcoat Co., Ltd. is planning to put a unit capable of eliminating fluorine and sulfur from exhaust gas on the market. This unit, which is a combination of a cellkit scrubber as gas absorption unit and a pre-coat-type exhaust gas treatment unit using the dehydration and drying method developed by Hiratsuka Environment Research Institute, is characterized by an excellent capacity to remove F and S, low operation costs, simple maintenance and operation, and compactness. The unit consists of a cooling process, absorption process, exhaust gas treatment process, and filtration-dehydration process. Exhaust gas is normally at such a high temperature that it must be cooled by spraying water prior to the absorption process. If powder dust is present in much quantity, it can be removed with a cooling tower. If a cellkit fan is placed between the cooling tower and the absorption tower, it helps to prevent the smoke duct from being corroded.

72139

Japan Environmental Agency

THE FUTURE OF ENVIRONMENTAL CONSERVATION. In: Quality of the Environment in Japan. p. 57-80, 1974.

Local air control measures in Japan are evaluated and the scientific research and development upon which conservation is based is discussed. Pollution control on the local level advanced through preventive regulations and pollution prevention agreements with local firms. The use of automatic measurement and concentrated monitoring systems is widespread. Expenditures for anti-pollution measures increased twofold from 1970-1972. In 1972, 432 facilities were ordered to improve pollution control measures. The number of prefectures setting higher standards are tabulated for soot and dust, cadmium and its compounds, fluorine, hydrogen chlorine, and lead its compounds. Problems associated with environmental administration include the prevention of pollution by high speed transportation, long range planning for environmental conservation, and strengthening of environmental controls. Scientific technology on environmental conservation includes: pollution prevention techniques required to minimize emissions from human activities causing pollution; physical, chemical, and biological studies of causes of air pollution and the mobility, composition, and reaction phenomena occurring in these environments; and study and assessment of how pollutants affect man, animals, and plants.

72656

Wilson, H. H.

A SURVEY OF FLUORINE EMISSION FROM CERAMIC FIRING PROCESSES. J. Aust. Ceram, Soc., 10(3):53-55, Nov. 1974. 28 refs.

The occurrence and control of fluorine emissions during ceramic manufacture are reviewed. Fluorine in exhaust gases is present mainly as gaseous hydrogen fluoride and silicon tetrafluoride and particulate calcium fluoride. Approximately 30-40% of the fluorine is evolved during normal firing, with the amount of emission increasing as the temperature of the process is increased. Fluorine removal efficiencies of over 99% can be achieved with wet scrubbing, though the disposal of the resultant acidic water is a problem. Dry methods of fluorine removal include the use of fluidized-bed reactors, the injection of hydrated lime into the exhaust flue, and adsorption with charcoal. Process modifications involving the removal of fluorides from raw materials or the use of electric heating to reduce the temperature of the glass can also be employed in some sections of the ceramic industry to reduce fluorine emissions.

73031

Feige, N. G.

CORROSION SERVICE EXPERIENCE AND ECONOMICS OF TITANIUM S USAGE IN GAS SCRUBBING EQUIPMENT FOR REFUSE INCINERATORS. Preprint, National Assoc. of Corrosion Engineers, Houston, Tex., 9p., 1974. 8 refs. (Presented at the National Association of Corrosion Engineers, Annual Meeting, Chicago, Ill., March 7, 1974.)

The economics of titanium usage in gas scrubbing equipment serving refuse incinerators is considered in terms of laboratory corrosion test results and field operation experience. Titanium resistant to incinerator flue gas environments which contain such corrosive materials as hydrogen chloride, sulfur dioxide, sulfur trioxide, trace hydrogen fluoride, and organic acids. The resistance of the metal to attack is adequate over the pH range of 1.5-11 and up to temperatures of 230 F for general pitting attach and 165 F for crevice corrosion. Trace amounts of ferric ions in the system can extend the range of immunity to attack. Economic considerations favor titanium at either end of the scrubber. The inlet area is very sensitive to water flow and temperature flares from the incinerator; and, since the amount of surface is small in this corrosion area compared to the total unit, titanium is a reasonable cost/performance selection. Titanium is also economically favored for the induced-draft fan rotor assembly.

73175

Yokota, N., N. Suzuki, and T. Mitsui

GAS ABSORPTION APPARATUS. (Gasu kyushu sochi). Text in Japanese. (Showa Denko Co., Ltd., Tokyo (Japan)) Japan. Pat. Sho 49-43468. 3p., Nov. 21, 1974. 1 ref. (Appl. Dec. 22, 1970, 1 claim).

The absorbent holder device for a gas adsorption tower consists of several sheets of plastic or metal nets with three or more bends at angles of 10-45 deg to the vertical line which are placed vertically at equal intervals. The absorbent is applied to nets by spraying absorbent solution from a spray nozzle located at the top of the tower. For example, 10% sodium carbonate solution is sprayed to nets and used for the absorption of hydrogen fluoride. The absorbed substance is removed by spraying water or Na2CO3 solution in the case of HF absorption. Advantages of this device are the simple procedure and efficient absorption, since the pressure loss of gas flow is slight due to its net structure.

74480

Kammholz, H. and E. Cerwenka

REDUCTION OF THE POLLUTANT EMISSION FROM INCINERATORS BY DRY SCAVENGING. (Verminderung der Schadgasemissionen von Muellverbrennungsanlagen durch Trockenwaesche). Text in German. VGB Kraftwerkstechnik, 55(4):234-239, April 1975. 13 refs.

The additive mytrid, a caustically burned magnesite with a porous structure to provide a large surface area (fineness: 90% below 90 micron, at least 80% below 60 micron, and at least 70% below 40 micron; specific surface of 15 to 20 sq m/q), was injected into the combustion chamber of an incinerator. The emission of following pollutants from a treated and untreated combustion unit was measured: hydrogen chloride, hydrogen fluoride, sulfur dioxide and trioxide, and the oxides of nitrogen. Each of the two units had a trash throughput of 19 tons/hr. The effect of the additive on the pollutant emission was determined from the difference between the measured pollutant concentrations in the waste gases from the two units. The results are graphically illustrated. With regard to the emissions SO2, SO3, HCl, and HF, mytrid had a reducing effect; no effect was observed with regard to the emissions of oxides of nitrogen. The composition of the fly ash from the two units hardly differed. The dust concentration of the cleaned gas did not increase. Further long-term measurements are required.

74483

Rasch, Rudolf

POLLUTANT ELIMINATION FROM FLUE GASES OF INCINERATORS. (Schadstoffeliminierung aus Rauchgasen von Muellverbrennungsanlagen). Text in German. Muell Abfall, 7(4):91-96, 1975. 26 refs.

Waste gas cleaning methods applied to incinerators focus on the removal of hydrogen chloride and fluoride. The hydrogen chloride concentration in the cleaned gas may not exceed 100 mg/cu m air. The maximum air concentration according to new regulations may over long periods of time not exceed 0.1 mg/cu m air. Dry binding of hydrogen chloride to alkaline fly ash or to suitable additives such as ground quicklime, calcium hydrate or limestone, or dolomite and magnesite presently receives great attention but requires further development. If a scrubbing process is selected for elimination of the hydrogen chloride, the flue gases are first cleaned of dust to reduce the sludge quantity at the end of the cleaning process. The benefit of scrubbing is hotly debated primarily because of the waste water problem it creates. A recent process using an endless cloth filter which moves over rollers like a vertically arranged conveyor belt achieved a good retentio efficiency for hydrogen chloride.

75138

Miller, D. R., H. R. Null, and Q. E. Thompson

OPTIMUM WORKING FLUIDS FOR AUTOMOTIVE RANKINE ENGINES. VOLUME II - TECHNICAL SECTION. Monsanto Research Corp., St. Louis, Mo., Environmental Protection Agency Contract 68-04-0030, Rept. APTD-1564, 202p., June 1973. 61 refs. NTIS: PB 239248/AS

Various working fluids for automotive Rankine engines were evaluated in terms of cycle efficiency, toxicity, flammability and combustion products, and stability. Two final candidate fluids were selected as being the most desirable: a 60/40 mol% mixture of pentafluorobenzene/hexafluorobenzene, designated as RC-1, and a 65/35 mol% mixture of water/2-methylpyridine, designated as RC-2. Rat inhalation studies revealed 4-hour median lethal concentrations of 16,000 ppm and 8000 ppm for RC-1 and RC-2, respectively. Combustion tests involving the burning of the working fluids with propane-air demonstrated the production of relatively high concentrations of carbon monoxide (612 + or - 66 ppm) and hydrogen fluoride (746 + or - 80 ppm) for RC-1; unburned hydrocarbons were also high for RC-1 (935 + or - 72 ppm). Combustion of RC-2 was more complete and resulted in much lower concentrations of the above components; however, nitrogen cyanide and nitrogen oxides were emitted in amounts of 0.5 and 79 + or - 6 ppm, respectively. Fluid RC-1 came nearest to satisfying the automotive organic working fluid requirements, with fluid RC-2 being selected as a back-up candidate for automotive use.

75204

Kalfadelis, C. D., E. M. Magee, G. E. Milliman, and T. D. Searl

EVALUATION OF POLLUTION CONTROL IN FOSSIL FUEL CONVERSION PROCESSES. ANALYTICAL TEST PLAN (FINAL REPORT). Exxon Research and Engineering Co., Linden, N. J., Environmental Protection Agency Contract

68-02-0629, Program Element 1AB013, ROAP 21ADD-023, Rept. EPAe650/2-74-009-1, 184p., Oct. 1975. 66 refs.

Process and waste streams in the Lurgi coal gasification process and the Char-Oil-Energy Development (COED) coal liquefaction process are reviewed in terms of analytical requirements for assessing their pollution potential. Descriptions of each step in the above processes are presented along with analytical procedures for obtaining data on particulates, polynuclear compounds, hydrocarbons, carbon monoxide, organic sulfur compounds, sulfur dioxide, sulfuric acid mist, nitrogen dioxide, aldehydes, ammonia, phenols, cyanide, arsine, mercury, beryllium, fluorides, hydrogen fluoride, nickel and iron carbonyls, and hydrogen selenide.

75387

Vogel, G. J., W. M. Swift, J. F. Lenc, P. T. Cunningham, W. I. Wilson, A. F. Panek, F. G. Teats, and A. A. Jonke

REDUCTION OF ATMOSPHERIC POLLUTION BY THE APPLICATION OF FLUIDIZED-BED COMBUSTION AND REGENERATION OF SULFUR-CONTAINING ADDITIVES (ANNUAL REPORT). Argonne National Lab., Ill., Environmental Protection Agency Interagency Agreement EPA-IAG-149(D) and Office of Coal Research Interagency Agreement OCR-IAG-14-32-0001-1543, Program Element 1AB013, ROAP 21ADB-011, ANL/ES-CEN-1007, Rept. EPA-650/2-74-104, 136p., Sept. 1974. 26 refs.

A bench-scale, fluidized-bed combustion pilot plant capable of operating at 10 atmospheres pressure was used to evaluate the effects of operating variables on flue gas sulfur dioxide and nitrogen oxide levels, combustion efficiency, additive utilization, and heat transfer. High retentions of sulfur (greater than 90%) and low NO levels (less than 150 ppm) were achieved with a fluidized bed of dolomite where SO2 reacted with lime in the dolomite to form calcium sulfate. The combustor was successfully tested using a variety of coals: highly caking, high-volatile bituminous, high ash subbituminous, and low-heating value lignite. The kinetics of the reaction of half-calcined dolomite with SO2 were first order with respect to SO2 concentration in the presence of water vapor and approximately three-fourths order in the absence of water vapor. Material balances were obtained for mercury, lead, beryllium, and fluoride; data were also obtained for sodium concentration in the particulate matter entrained in the flue gas from the combustor. (Author abstract modified)

76008

Calvert, Seymour and Samuel Stalberg

EVALUATION OF SYSTEMS FOR CONTROL OF EMISSION FROM ROCKET MOTORS - PHASE I (INTERIM REPORT). A.P.T., Inc., San Diego, Calif., Air Force Rocket Propulsion Laboratory and Environmental Protection Agency Interagency Agreement EPA-IAG-R5-0644, Contract 68-02-1328, Task 8, Program Element 1AB012, ROAP 21ADL-010, Rept. EPA-600/2-75-021-a, 57p., Aug. 1975. 5 refs. NTIS: PB 245590/AS

An engineering evaluation of methods for controlling emissions from solid rocket test firings is presented. The primary emissions requiring control are carbon monoxide, hydrogen chloride, hydrogen fluoride and aluminum oxide particles. A pilot scale scrubber currently in operation on a 22,200 newton (5000 lb) motor is examined and appears to require an excessive amount of water if scaled up for a rocket of larger thrust. Scoops appear to provide one simple means of reducing the quantity of scrubbing water required. Pilot-scale tests to determine the technical feasibility of the idea are recommended. (Author abstract modified)

76232

Farrier, P. M. and F. I. Coates

INFLUENTIAL FACTORS IN THE CONTROL OF EFFLUENT EMISSIONS FROM THE BLUFF ALUMINUM SMELTER. The Clean Air Society of Australia and New Zealand, Clean Air Conf. 1975 Proc., Rotorua, New Zealand, 1975, p. 511-527. 6 refs. (Feb. 17-21.)

Procedures for the control and monitoring of particulate and fluoride emissions from an aluminum smelter are described. The monitoring program includes measurements of control equipment efficiency and the determination of fluoride levels in the surrounding air as well as in flora and fauna. Fluoride emissions from pot operation are minimized as a result of the installation of a prebake cell. The emissions from aluminum reduction pots are collected in a common duct and passed through a multicyclone for the removal of particulates. The cleansed effluent is then discharged through a 137-meter high stack at a velocity of 1.6 m/sec. Each pot is completely hooded, and an effluent containment in excess of 97.5% is constantly maintained.

76512

Parekh, Rashmi

EQUIPMENT FOR CONTROLLING GASEOUS POLLUTANTS. Chem. Eng./Deskbook, vol. 1975:129-133, Oct. 6, 1975.

Equipment for controlling gaseous pollutants is classified according to the function it performs. Gas liquid absorption processes are carried out in vertical countercurrent flow through packed, plate, or spray towers. The equipment falls into the following categories: dispersed gas: impingement plate scrubbers; dispersed liquid: packed towers, wetted-wall towers; dispersed liquid: spray towers, venturi scrubbers. A major factor in the successful operation of a scrubber is the proper selection of materials for construction. The units are subjected to harsh environments created by industrial gases such as sulfur dioxide, sulfur trioxide, hydrogen chloride, hydrogen fluoride, and chlorine, which form sulfurous, sulfuric, hydrochloric, and hydrofluoric acids as they enter the liquid phase. Materials selections must be based on specific application requirements. Incineration is the simplest route when the gas streams are combustible. Direct flame and catalytic oxidation are the two methods in common use today.

77475

Gerstein, Steven M. and Mark E. Franza

CONTROL TECHNOLOGY FOR SECONDARY ALUMINUM SMELTERS. Preprint, Air Pollution Control Assoc., Pittsburgh, Pa., 14p., 1975. 11 refs. (Presented at the Air Pollution Control Association, Annual Meeting, 68th, Boston, Mass., June 15-20, 1975, Paper 75-66.6.)

A dry absorption-filtration system for controlling particulate and gaseous (chlorine, hydrogen chloride, and hydrogen fluoride) emissions from a secondary aluminum smelter is described. The basic component of the system is a baghouse coated with a chromatographic material capable of absorbing acid gases in a gas-solid reaction. The chromatographic coating filters submicron materials prevents submicron particle permeation of the bag filter cloth. Bags are shaken every 3-5 days. Outlet particulate loadings for the system are less than 0.005 grains/standard cu ft, and the opacity of the plume is zero. The average acid gas emission is 10 ppm or less. The bag life is conservatively estimated at 10 yr. The annual operating cost, including amortization, for the system is about $2.00/ton of aluminum. (Author abstract modified)

77816

Graetz, R.

POSSIBLE METHODS FOR THE CONTROL OF FLUORIDE EMISSIONS AND INFORMATION OBTAINED FROM CONTINUOUS MEASUREMENTS OF FLUORIDE IN FLUE GAS. (Moeglichkeiten zur Beeinflussung der Fluor-Emissionen und Erkenntnisse aus kontinuerlichen Fluor-Messungen im Rauchgas). Text in German. Ziegelind. (Weisbaden), 4:130-138, April 1975. 11 refs.

Methods for the control of fluoride emissions from brickworks are reviewed along with factors affecting the fluoride content of ceramic materials. Fluoride emission control techniques include: the prevention of fluoride discharge from materials being fired, the chemical reaction of gaseous fluoride compounds with other compounds to render the former harmless, and dilution of flue gas by the use of tall stacks. The fluoride content ceramic materials varies in concentration and depends on the chemical and mineralogical constitution and the geological origin of the clays. Thus far, no conclusions on the efficiency of methods for the continuous monitoring of fluorides in flue gas can be drawn.

77838

Swift, W. M., G. J. Vogel, and A. F. Panek

POTENTIAL OF FLUIDIZED-BED COMBUSTION FOR REDUCING TRACE-ELEMENT EMISSIONS. Preprint, Air Pollution Control Assoc., Pittsburgh, Pa., 19p., 1975. 8 refs. (Presented at the Air Pollution Control Association, Annual Meeting, 68th, Boston, Mass., June 15-20, 1975, Paper 75-46.3.)

The potential of fluidized-bed combustion for reducing trace element emissions as compared with conventional coal combustion systems was evaluated using a bench scale, 6-inch diameter, pressurized, fluidized-bed combustor. Overall mass balances for the elements lead, cobalt, iron, potassium, lanthanum, sodium, and scandium possessed material balances of 100 + or - 10%, indicating essentially no losses of these elements by volatilization. Retention of the relatively volatile elements mercury, fluorine, bromine, and arsenic indicated a definite potential for the reduction of emissions of these elements via fluidized-bed combustion. Concentrations of trace elements in coal and fly ash samples from successive stages of gas cleaning devices (primary cyclones, secondary cyclones, and filters) were adjusted to a combustible-matter-free basis and compared for significant differences in concentration between coal and ash samples and for successively finer samples of ash. The concentrations of elements such as barium, cobalt, lanthanum, antimony, scandium, and tantalum showed slight tendencies to increase with decreasing particle size. The lower combustion temperatures of fluidized-bed combustion were apparently effective, however, in reducing the preferential concentration of trace elements in the finer ash particles. (Author abstract modified)

78245

Glowiak, Bohdan and Adam Gostonczyk

INDUSTRIAL GAS CLEANING BY ION EXCHANGERS. (Oczyszczanie gazow przemyslowych metoda jonitowa). Text in Polish. Ochrona Pracy (Prague), (11):17-18, Nov. 1974. 5 refs.

Results of an investigation on the applicability of ion exchangers to remove acidic impurities from industrial gases are described. The device operates on the principle of sorption of acidic gases by ionic substances with simultaneous and continuous regeneration. The concentration of gases can be arbitrary. The temperature of the gases being cleaned should not be higher than 333 K and a preliminary removal of dust particles is required. The process can use practically all industrial anions capable of absorbing HSO3 and SO3 anions from aqueous solutions. The diameter of the anionic particles must be greater than 0.004. The process can have an effectiveness of 99% when it is used for removal of such acidic impurities as sulfur dioxide, nitrogen oxides and hydrogen fluorides. The process can therefore be used to clean industrial gases from sulfuric acid plants, emissions from phosphate fertilizer plants from glass- works, from aluminum smelting plants.

78814

Kisters, T.

FLUE GAS CLEANING BEHIND REFUSE INCINERATING PLANTS - PROBLEMS AND THEIR SOLUTIONS. (Rauchgasreinigung hinter abfallverbrennungsanlangen - Probleme und Loesungsmoeglichkeiten). Text in German. Aufbereitungs-Technik, 16(5):231-236, May 1975.

Techniques and equipment for flue gas cleaning behind waste incinerators are described. The incinerator flue gases usually contain 5-15 g dust, 1000-2000 mg hydrochloric acid, and up to 20 mg hydrofluoric acid per N cu m. The maximum allowable emission concentrations are 100 mg/N cu m for dust and chlorine, and 5 mg/N cu m for fluorine. Suspended matter can be separated most efficiently and economically in electrostatic dust separators which require preliminary flue gas cooling because they can not be operated permanently at temperatures over 300 C. Sulfur dioxide, HCl and HF can be separated by wet absorption or adsorption methods, using water, aqueous solutions of calcium hydroxide or sodium hydroxide, or limestone. Limestone is used most efficiently in fluidized-bed operations. The admission of pulverized limestone into the flue gas is less efficient. The gases require cooling before, and heating after the wet separation of gaseous components.

78890

Westphal, Bernhard W. and Juergen Boehme

TRASH AND SEWAGE SLUDGE INCINERATION PLANT KREFELD. (Muell- und Klaerschlammverbrennungsanlage Krefeld). Text in German. Energie, 27(5):122-130, 1975.

The combined municipal waste and sewage sludge incinerator plant constructed recently in Krefeld, West Germany, is described. Waste incineration is done on Duesseldorf system grates in a temperature range of 800-1200 C. The hot flue gases are cooled and dedusted in an electrostatic precipitator, after which they are washed for the removal of hydrochloric acid, hydrofluoric acid, and sulfur dioxide. The air pollutant emission from the waste incinerator plant is negligible.

79079

Huenlich, Hans-Werner

STATEMENT ON CURRENT PRACTICE FOR THE REDUCTION OF FLUORIDE EMISSION IN THE BRICK AND TILE INDUSTRIES BY SCRUBBING OF THE FLUE GASES. (Feststellung des Standes der Technik zur Verminderung der Fluoremission in der Ziegelindustrie durch Reinigung der Abgase). Text in German. Ziegelind. (Weisbaden), no. 4:155-162, 1974.

Fluoride occurs as a trace element in fuels and in many raw materials for ceramics. It is seldom possible for it to be completely stabilized in the ceramic body during firing. An attempt is therefore made to neutralize the harmful gaseous fluoride compounds in the flue gas. A survey of the literature on the subject presents the processes used to date, both inside and outside the ceramic industries, for the conversion of the gaseous fluoride compounds in the flue gas into harmless com-

pounds in the form of dust particles. The further development of the lime injection process and the necessary removal of the dust particles thus produced are singled out for particular emphasis. (Author abstract)

79657

Davids, Peter

EFFLUENTS FROM GAS SCRUBBERS IN INCINERATORS. (Abswaesser der Gaswaesch von Verbrunnungsanlagan). Text in German. Muell Abfall, 7(5):144-146, 1975.

Problems of flue gas cleaning after trash incinerators and related wastewater problems are discussed. The dust, hydrochloric acid, and hydrofluoric acid emissions from waste incinerators are limited to 100 mg/cu m; 100 mg/cu m, and to 5 mg/cu m, respectively, which requires the separation of dust and of the gaseou. pollutants, which can be combined in scrubbers. Due to their high water-solubility, HCl and HF can be separated by means of water. If the scrubber effluents are to be discharged into recipients, the specific water consumption should be increased to 10-15 cm m/ton of waste to obtain a dilute effluent. If the effluent is to be treated before discharge, the water consumption should be minimized, which is possible by recirculation and counterflow processes. Thus, it is possible to obtain an acid with 10% concentration, and to achieve a water entrainment of 0.04 cu m/ton of waste. It is also possible to use lime suspension for flue gas scrubbing without wastewater treatment.

79711

Tabasaran, Oktay

ENVIRONMENT BALANCES AND TRASH PYROLYSIS. (Umweltbilanzen bei der Abfallpyrolyse). Text in German. Muell Abfall, 7(5):127-131, 1975. (Presented at the Waste Technology Colloquium, 28th Stuttgart, West Germany, March 14, 1975.)

The environmental and energetical balances of trash pyrolysis according to the Destrugas and Goldshoefe processes are drawn up on the basis of actual measurements on technical-scale pilot plants. The waste gases generated in the Destrugas degassing process at a pyrolytic temperature of 1000 C are scrubbed, and a fuel gas is obtained. With trash with a calorific value of 1900 kcal/kg, 360 kg of gas with a calorific value of 2790 kcal/N cu m are obtained per ton of trash. This gas contains 39.5% hydrogen, 17.6% carbon dioxide, 18.6% water, 21.1% carbon monoxide, 9% methane, and 3.2% other hydrocarbons by volume, as well as 404 mg sulfur oxides, 35 mg hydrochloric acid, 1 mg hydrofluoric acid, 170 micrograms mercury per N cu m, 400 ppm hydrogen sulfide, 59 ppm hydrocyanic acid, and 1185 ppm triethylamine. In the Goldshoefe process, in which hydrocarbons are cracked at 1200 C in coke bed, and part of the water added is converted into hydrogen, 100 kg of raw waste generated 106.9 kg of cleaned gas with a calorific value of 1400 kcal/N cu m. After scrubbing, this gas contains 51% nitrogen, 20% hydrogen, 14% CO, 8%, CO2, 3% oxygen, 3% methane, 1% other hydrocarbons, as well as 120 ppm of ammonia, 30 ppm hydrocyanic acid, 20 ppm SO2, and 10 ppm H2S. Both processes generate gases which represent hardly any environmental hazard, and the volume of these pyrolysis gases amounts to about 10% of that generated by conventional incineration. The low dust content makes electrostatic precipitators unnecessary. The pyrolysis gas incorporated about two thirds of the energy content of the waste, and 50% of this recovered energy is needed for the pyrolytic process.

80213

Organisation for Economic Co-operation and Development, Paris (France), Environment Directorate

AIR POLLUTION BY FLUORINE COMPOUNDS FROM PRIMARY ALUMINIUM SMELTING. 44p., 1973. 18 refs.

Emission of fluorine compounds is the major air pollution problem of the primary aluminum smelting industry. Typical data regarding quantity and composition of fluorine air pollutants released in the various processes using different types of electrolysis pots are given. Some pots are designed with a hood which allows a considerable fraction of the release to be collected in a relatively concentrated form. Typical data regarding collection efficiencies are exhaust and ventilation requirements for pot rooms are given. Electrostatic precipitators, scrubbers, and bag filters are used for cleaning pot exhaust. Adsorption of hydrogen fluoride on alumina to recover fluorine compounds is used increasingly. The most efficient gas cleaning systems operate at above 90% efficiency. Total emissions obtainable with combination of pots and gas cleaning equipment are calculated. The investment in medium or highly efficient gas cleaning systems ranges from 5% to 10% of the investment in the electrolysis plant. According to data received from 12 countries representing 71% of the aluminum production in the Organisation for Economic Co-operation and Development area, 23% of the production takes place in plants having highly efficient gas cleaning. About 8% is produced in plants having no gas cleaning. (Author abstract modified)

80356

Novikov, A. I., A. N. Skvortsov, and V. A. Kishkarev

CONICAL SCRUBBERS WITH FLUIDIZED SPHERICAL PACKING FOR GAS PURIFICATION. Intern. Chem. Eng., 15(3):530-533, July 1975. 4 refs.

The characteristics and applications of conical scrubbers with fluidized spherical packing (CSS) in spraying and ejection variations are discussed. The packing is fluidized most intensively near the lower base of the cone, and gradually slows down along the height. The upper, slightly mobile layers of spheres serve to partially recover the spray which is formed in large amounts near the lower base of the cone. Upper grids with a layer of spheres having a height of 150 mm are provided for more complete recovery of the spray in the cylindrical part of the units. These grids do not become clogged with residue and have practically no effect on the overall resistance of the scrubber. For spheres of silicon tetrafluoride, hydrogen fluoride, and dust with a diameter of 34-40 mm, the maximum recovery capacity is achieved with a static bed height of HO equals 500-800 mm.

80500

DUST BURNS FREELY SUSPENDED. TRASH AND SEWAGE SLUDGE INCINERATION PLANT IN KREFELD TAKEN INTO OPERATION. (Staub verbrennt freischwebend. Muell- und Klaerschlamm-Verbrennungsanlage in Krefeld in Betrieb genommen). Text in German. VDI Nachr. (Ver. Deut. Ingr.) (Berlin), 29(48):7, 1975.

The new combined waste incinerator and wastewater treatment plant of the city of Frefeld, designed to incinerate 105,000 tons of wastes and 25,000 tons of sewage sludge, is described. The sewage sludge, dried and ground, is admitted to the incinerator together with the vapors generated in the drying and grinding process, and is incinerated freely suspended over the grate. The steam produced is used for electricity generation for the incinerator and wastewater treatment plant,

and the exhaust steam is used for remote heating. The flue gases are dedusted in an electrostatic precipitator, after which they are washed in two stages for the removal of hydrochloric acid in the first stage, and of sulfur dioxide and hydrofluoric acid in the second. The cleaned gases are mixed with hot air before discharge into the atmosphere.

80863

Morgunova, E. M., V. B. Vedernikov, O. P. Subbotina, A. N. Semenov, and M. N. Gafarov

LIBERATION OF FLUORINE-BEARING GASES IN SEMIHYDRATE PRODUCTION OF WET-PROCESS PHOSPHORIC ACID. (Vydelenie ftoristykh gazov v proizvodstve polugidratnoi ekstraktsionnoi H3PO4). Sov. Chem. Ind. (English translation from Russian of: Khim, Prom.), 6(8):507-508, 1974. 5 refs.

The liberation of fluorine-bearing gases during the semihydrate production of wet-process phosphoric acid was studied. About 32% of the fluorine from the apatite concentrate was found in the tail gas given off by the process. The fluorine:phosphorus pentoxie ratio of the gas phase was over 200, indicating that the tail gas can be used for synthesis of a suitable feed for the production of aluminum fluoride. It is necessary to install a system for removing phosphoric acid spray from the fluorine-bearing gas exiting from the concentrators, however, to obtain a fluosilicic acid suitable for aluminum fluoride production.

80950

Kirov, N. Y.

THE SAMPLING CHARACTERIZATION AND ASSESSMENT OF SOLID WASTES AS A FUEL. New South Wales Univ., Sydney (Australia), Dept. of Fuel Technology, Convers. Refuse Energy Int. Conf. Tech. Exhib., 1st, Montreux, Switzerland, 1975, 6p. 4 refs. (Nov. 3-5.)

The characteristics of solid wastes that are necessary for the successful conversion of refuse to energy are discussed. The parameters of importance to incinerator design in relation to handling, storage, combustion characteristics, maintenance, plant availability, and air pollution potential include: total weight, bulk density, moisture, calorific value, proximate and ultimate analyses, size distribution, ash fusion characteristics, and the presence of any undesirable elements, such as metals (mercury, arsenic, lead, tin, aluminum, and zinc), sulfur, chlorine, fluorine, phosphorus, nitrogeneous wastes and alkalis which may cause fouling, slagging, corrosion, or air pollution problems.

81040

Barber, J. C.

POLLUTION CONTROL IN FERTILIZER MANUFACTURE. J. Environ. Quality, 4(1):1-11, Jan.-March 1975. 19 refs. (Presented at the American Society of Agronomy, Annual Meeting, 65th, Las Vegas, Nev., Nov. 15, 1973.)

Regulations and standards for air pollution and industrial hygiene affecting fertilizer production are discussed. Technology available for the abatement of air and water pollution and for control of dust in the working environment is described. Technology has not yet been developed to cope with the particulate emission problems at ammonium nitrate and urea prilling towers. Both air and water pollution problems at new nitrogen fertilizer production facilities can be lessened by the selection of low energy scrubbers. Plant tests are currently being made with a low pressure drop impingement type of scrubber. One possible solution for new plants is to granulate ammonium nitrate and urea in equipment which is amenable to particulate emission abatement. Dust scrubber effluents and plant washdown obtained at granular fertilizer plants can be converted into liquid fertilizers; however, the dust collection system should be designed to avoid excessive dust pickup. Much progress has been made toward recovery of by-product fluorine, but by-product gypsum recovery involves large capital investment and extensive market development. Water pollution is also discussed. (Author abstract modified)

81256

Reissmann, H.

FLUE GAS CLEANING AND FLUE GAS SCRUBBING IN INCINERATION PLANTS. (Rauchgasreinigung und Rauchgaswaesche bei Muellverbrennungsanlagen). Text in German. Preprint, VGB Technical Association of Large Power Plant Operators E.V., Essen, 12p., 1975. 6 refs. (Presented at the VGB Incineration Conference, Hagen and Stuttgart, West Germany, April 4 and 18, 1975.)

Problems and possibilities of dust separation and gas scrubbing at municipal and special waste incinerator plants are described. Dry mechanical dust separators are unable to guarantee compliance with the new dust emission standard of 100 mg/N cu m. Therefore, they are used sometimes as a first stage before electrostatic precipitators which reach efficiencies of up to 98-99%. The flue gas temperature in the electrostatic precipitator should be between 250-280 C to prevent hot-temperature corrosion or temperature drops to below the dew point. The efficiency of precipitators is determined not only by the precipitating surface area but also by the spacing between the precipitating electrodes. Wet type dust separators can use an accelerating diaphragm immediately behind the incinerator if the flue gas volume is fairly constant. For fluctuating flue gas volumes, venturi scrubbers with adjustable flow cross-section as a function of the flue gas flow is most suitable. While the carbon monoxide emission can be abated by adequate process control, chlorine and fluorine emissions require flue gas scrubbing with sufficient contact time between the flue gases and the absorbent liquid. Sulfur dioxide, sulfur trioxide and carbon dioxide are also separated partially. Dry methods, i.e., the use of calcia, do not guarantee compliance with the emission standards (100 mg/N cu m for Cl, and 5 mg/N cu m for F).

81645

St. Cyr, Lewis A. and Loren H. Young

PREVENTION OF AIR POLLUTION BY USING ACTIVATED ALUMINA SOLID ADSORBENT TO REMOVE PARTICULATES OF LESS THAN 0.5 MICRONS FROM FLUE GASES. (Vulcan Materials Co., Birmingham, Ala.) U. S. Pat. 3,900,298. 6p., Aug. 19, 1975. 5 refs. (App. July 13, 1973, 2 claims).

An air pollution control process for the prevention of white smoke in the atmosphere caused by finely divided metal halide solids is described. Particulates less than 05. micron in size are removed from flue gases by passing the flue gases into intimate contact with a solid adsorbent of activated alumina. The solid adsorbent is particularly useful in removing metal halide solids such as aluminum chloride, potassium chloride, sodium chloride, and aluminum fluoride of less than 0.1 micron in size from the gaseous effluent of aluminum processing operations which utilize a gaseous chlorine treatment of molten aluminum. Activated alumina has not been used in any other process because it is widely believed that solid adsorbents are ineffective in removing submicron particulates and that liquid adsorbents, such as caustic or alkaline solutions are needed. (Author abstract modified)

81772

Kurian, P. C.

POLLUTION PROBLEM AT E.I.D-PARRY LIMITED FERTILISER FACTORY AT RANIPET. Fertiliser News, 18(9):17-18, Sept. 1973.

Stack emissions generated by a superphosphate and sulfuric acid plant associated with a fertilizer manufacturing operation are described along with methods for their control. The main effluent from the sulfuric acid plant is unconverted or unabsorbed sulfur dioxide which generally does not exceed 0.2%. A maximum conversion of SO2 to sulfur trioxide is achieved when the plant is operated at a SO2 input to the converter of 7-7.5%. Emissions are controlled by dispersion using a 30.5-meter high stack. Emissions from the superphosphate plant include silicon tetrafluoride, hydrogen fluoride, hydrogen chloride, and fluorine, with the latter compound being the main pollutant. These gases are controlled by absorption in a spray tower. The absorption efficiency of the scrubber ranges from 65-70%. Unabsorbed gas from the scrubber is discharged through a stack that is 21.3 m above ground level.

81773

Latey, N. G.

POLLUTION IN PHOSPHATIC FERTILISER PLANT. Fertiliser News, 18(7):29-30, July 1973.

Gaseous and particulate emissions generated by superphosphate and sulfuric acid plants associated with a phosphatic fertilizer manufacturing operation are reviewed along with methods for their control. Sulfuric acid plant emissions consist mainly of sulfur dioxide and sulfur trioxide. These pollutants, though uncontrolled, are generally maintained at 0.1-0.12% and 0.01-0.14%, respectively, of the stack gas composition. Fluorine, hydrogen fluoride, and silicon tetrafluoride are the main gaseous emissions generated by the superphosphate plant. These emissions are controlled by a combination of spray scrubbing and wet cyclone treatment. Dust emissions arising from the superphosphate plant are controlled by bag filters.

81944

Achorn, Frank P., Hubert L. Balay, annd David G. Salladay

FLUORINE RECOVERY FROM SUPERPHOSPHATE PLANTS. Preprint, American Chemical Society, Washington, D. C., 31p., 1975. 5 refs. (Presented at the American Chemical Society Meeting, Chicago, Ill., Aug. 24-29, 1975.)

Information concerning some of the commercial practices for the recovery of fluorine from superphosphate plants is presented. Possible uses for such recovered F are also discussed in terms of economics and technology. The gas from normal superphosphate plants is usually scrubbed in an impingement scrubber or the more modern venturi type. Concentrated superphosphate plants are also discussed. Plant tests show that water scrubbing in either impingement or venturi scrubbers removes F, in the form of silicon tetrafluoride, effectively from the exit gases of superphosphate plants. Usually the venturi scrubber is more efficient and can utilize weak hexafluorosilane (H2SiF6) as a scrubbing medium to remove F effectively from superphosphate dens. A major problem with the recovery of F from superphosphate plants is disposal of the by-products from these systems.

81995

Boehm, Eberhard, Lothar Reh, Ernst Weckesser, Gunter Wilde, and Guenter Winkhaus

METHOD OF REMOVING HF FROM GASES. (Metallgesellschaft Aktiengesellschaft, Frankfurt am Main (West Germany) and Vereinigte Aluminiumwerke Aktiengesellschaft, Bonn (West Germany)) U. S. Pat. 3,907,971. 8p., Sept. 23, 1975. 5 refs. (Appl. Nov. 15, 1971, 3 claims).

A method for removing hydrogen fluoride from gas streams emitted by electrolysis cells used for the production of aluminum is described wherein contact between the gas phase and the solid phase is carried out in an expanded fluid bed to achieve increased removal efficiency over piror art methods. The waste gas is used as the fluidizing medium for an expanded fluid bed of particulate solids capable of taking up hydrogen fluoride. The solids content of the fluid bed chamber and the gas flow parameters are adjusted to maintain a continuous solids concentration gradient throughout a vertical chamber such that the concentration decreases from the bottom to the top of the chamber. A major proportion of the solids removed from the top of the bed and entrained in the gases can be separated from the effluent gas and returned to the chamber.

82032

Tsukamoto, Youji and Sadao Kondo

METHOD FOR REMOVING A FLUORINE COMPOUND(S) FROM GASEOUS MIXTURE THEREWITH. (Mitsubishi Gas Chemical Co., Inc., Tokyo (Japan)) U. S. Pat. 3,907,522. 6p., Sept. 23, 1975. 4 refs. (Appl. April 26, 1974, 11 claims).

A method for the efficient removal of fluorine compounds, particularly boron trifluoride, from gas streams is described which precludes the escape of the fluoride hydrate as mist. The gas mixture is first introduced into a gas scrubber of the gas-liquid contacting type. The gas removed from the scrubber is then introduced into a mist-catching device which comprises a porous filter medium (mean pore size of 60 micron of less) and a nozzle or nozzles positioned above the surface of the medium. Water or an aqueous alkaline solution is sprayed on the surface of the filter medium in the same direction as that of the gas stream.

82446

Fichtel, Konrad

TRASH PYROLYSIS: FOUR PROCESSES ARE RIPE FOR TESTING. (Hausmuell-Pyrolyse: Vier Verfahren koennen erprobt werden). Text in German. Umwelt (Duesseldorf), 5(4):42-50, 1975. 17 refs.

Four different trash pyrolysis processes (Destrugas process, Landguard process, Andco-Torrax process, and Purox process) are described and compared with regard to their technological and environmental advantages. The Destrugas and Purox processes require purification of the pyrolysis gas before combustion, which is not problematic because of the small gas volumes generated, while the Landguard Andco-Torrax processes offer but slight or no environmental advantages over the waste incineration process. Of the four different methods, the Destrugas method is most promising and is expected to become a valid alternative for incineration. In this process, crushed wastes are gradually heated up to 900-1000 C for cracking of the organic components. The process gas obtained contains water vapor, carbon dioxide, hydrogen, carbon monoxide, methane, and small quantities of higher hydrocarbons. The process gases are cooled and scrubbed to obtain a fuel gas composed essentially of hydrogen, CO, CO2, and

methane, which can be stored for later. The flue gases generated during the combustion of this gas contain 10 ppm of sulfur dioxide plus sulfur trioxide, 0.5 ppm of hydrofluoric acid, 10 ppm of hydrochloric acid, and 10 mg of soot/N cu m.

82918

Nix, Thomas B.

REMOVAL OF FLUORIDES FROM GASES. (Fuller Co., Catasauqua, Pa.) U. S. Pat. 3,876,394. 5p., April 8, 1975. 3 refs. (Appl. Oct. 10, 1973, 5 claims).

A method and apparatus for removing gaseous fluorides from gases evolved from an aluminum smelting furnace are described. The fluorides are removed by achieving intimate contact between finely divided particles of alumina and the fluoride containing gases. Particles of alumina are fed into a stream of gases collected from the aluminum smelting furnaces countercurrent to the flow of gases. The particles of alumina absorb the fluorides and are then separated in a cyclone. The alumina is fed to the smelting furnaces. Preferably two stages are used. In this method, cooling of the evolved gases is not as critical as in prior methods and apparatus for removing gaseous fluorides. (Author abstract modified)

83134

Horvath, Zoltan

ENVIRONMENTAL PROTECTION IN METALLURGY. (Kornyezetvedelem a femkohaszatban). Text in Hungarian. Banyasz. Kohasz. Lapok - Kohaszat, 108(7):321-325, July 1975. 17 refs.

Sulfur dioxide and fluorine emissions generated in copper, zinc, and lead metallurgy, and methods for their abatement are described. The sulfur dioxide emissions, originating from the ore sulfur content and from sulfur-containing fuels, can be abated by technological improvements, such as reduction of the flue gas volume with high SO2 concentration; the Kivcet, Worcra, Noranda, and Mitsubishi processes; and the wet processes which totally eliminate the emission problems. The SO2-containing flue gases are treated mostly with ammonium hydroxide, sodium hydroxide, or calcium hydroxide for SO2 removal, as exemplified by many new flue gas treatment units at leading metallurgical companies. These measures, including the construction of high stacks, permit at least 95% of the SO2 to be removed from the flue gases. Fluorine, for which the specific emission with respect to aluminum works is limited to 1 kg/ton of aluminum in the USA, France and other countries, can be abated by improved technological processes or flue gas treatment, consisting of scrubbing with acid, alkaline solution or water, or by adsorption on alumina in a dry fluidized-bed process.

83198

Aoki, Toshimitsu

MULTI-HOLE PLATE SCRUBBER. (Mezara shiki senjoto). Text in Japanese. Ebara Jiho (Ebara Times), no. 93:68-70, 1975.

A multi-hole plate scrubber (wet-type dust collector) developed by the Ebara Co. jointly with the Nippon Light Metal Co. is described. This scrubber was developed originally in 1972 for aluminum electrolysis factories, to collect waste hydrogen fluoride (HF) gas, but is now being used in steel refineries, stack desulfurization installations, and ceramic industries. Treatment capacities ranged from 800 cu m/min to 350,000 N cu m/hr. Temperatures ranged from 30 C to 160 C. Sodium hydroxide solution is used to absorb HF, sulfur dioxide, and sulfur trioxide gases. Absorption is made effective by thorough gas-liquid contact by the following means: droplets falling through the multi-hole plate; liquid films, stretched over the holes; gas passing through the f'ms; wet-wall effect by the honeycomb zone. Mist accompanying the treated gas is removed by means of an eliminator, and emitted into the atmosphere. Calcium and dust deposition from the industrial water used in the water supply can adversely affect the effectiveness of the installation. An annual or semi-annual maintenance check is recommended.

83613

Ishahaya, Fumio

EXHAUST GAS CLEANING APPARATUS. (Hitachi, Ltd., Japan)) U. S. Pat. 3,885,918. 6p., May 27, 1975. 3 refs. (Appl. Sept. 1, 1972, 18 claims).

An apparatus for removing acidic air pollutants from exhaust gas is described. A liquid containing alkali material is sprayed in a form of fine particles into exhaust gas containing acid material such as nitrogen oxides, sulfur oxides, fluorine gas, chlorine gas, and/or hydrogen chloride. The materials react with each other to produce solid particles which are separated from the exhaust gas. The solid particles are of predetermined size for easy separation.

83667

Fattinger, V.

WASHING OUT OF METAL OXIDES AND NOXIOUS GASES FROM WASTE INCINERATOR FLUE GASES TO ACHIEVE THE MAXIMUM POSSIBLE DEGREE OF WATER POLLUTION PREVENTION. (Auswaschen von Metalloxiden und Schadgasen aus Abfallverbrennungsanlagen unter weitgehender Vermeidung einer Abwasserverschmutzung). Text in German. CIBA-GEIGY AG, Basel (Switzerland), Convers. Refuse Energy, Int. Conf. Tech. Exhib., 1st, Montreux, Switzerland, 1975, 6p. 7 refs. (Nov. 3-5.)

A multi-stage system for the separation of particulate matter, sulfur dioxide, hydrogen chloride and hydrogen fluoride from waste incinerator flue gases, developed by CIBA-GEIGY A.G. is is described. The system adopts a controlled counterflow of flue gas and scrubbing liquid. It is composed of a coarse dust separator which also cools the gas and conditions the scrubbing liquid. The second stage is a scrubber for the removal of acid gaseous components and for the wetting of fine suspended dust. The third stage is a fine dust separator in the form of venturi scrubber or other types. The SO2 content of the flue gas is reduced by over 75%. No alkalies are used in the scrubbing liquid, but it is possible to increase the efficiency by the use of alkalies. The dilute sludge generated is neutralized with the incinerator ashes.

84391

Smith, William H. and Leon S. Dochinger

CAPABILITY OF METROPOLITAN TREES TO REDUCE ATMOSPHERIC CONTAMINANTS. Preprint, Yale Univ., New Haven, Conn., School of Forestry and Environmental Studies and Forest Service, Delaware, Ohio, Northeastern Forest Experiment Station, 29p., 1975. 78 refs. (Presented at Better Trees for Metropolitan Landscapes Symposium, Washington, D. C., Nov. 5, 1975.)

Evidence indicating that trees in urban environments may have considerable potential for removing both particulate and gaseous pollutants from the atmosphere is reviewed. Studies of uptake and removal mechanisms are discussed in relation to nitrogen oxides, sulfur oxides, carbon monoxide, hydrogen fluoride, chlorine, nitrates, ozone, peroxyacetylnitrate, fluorine, and heavy metals. Mechanisms for gaseous removal

include uptake via plant pores and surface adsorption. Particulate removal by trees may result from sedimentation or impaction onto tree surfaces and precipitation transfer to tree surfaces. Sufficient potential for this sink function is indicated to justify its consideration in tree selection and breeding programs for metropolitan trees.

84418

Rawlings, Gary D.

AIR POLLUTION ABATEMENT AT FERTILIZER MIXING PLANTS. Preprint, American Chemical Society, Washington, D. C., 37p., 1975. 11 refs. (Presented at the American Chemical Society Meeting, Chicago, Ill., Aug. 24-29, 1975.)

Air pollution abatement at three types of fertilizer mixing plants are described: ammoniation-granulation, bulk blend, and liquid mix. Emissions include: ammonia vapor and ammonium salts, chlorine vapor and inorganic salts, fluorine compounds, phosphorus compounds, and particulates. The type of air pollution control equipment used depends on plant type, production capacity, and operating conditions and includes cyclone and wet scrubbers, spray dedusters, spray towers, electrostatic precipitators, and filters. The collection efficiencies for various types of this equipment are tabulated.

C. MEASUREMENT METHODS

00126

M. R. Pack and D. F. Adams

PROBLEMS OF RELATING ATMOSPHERIC ANALYSES TO EFFECTS OF AIR POLLUTION ON AGRICULTURE. J. Air Pollution Control Assoc. 16, (4) 219-24, Apr. 1966.

This presentation has emphasized the deficiencies of methods of atmospheric analysis and the inadequacy of present understanding of the relationship of air pollution to plant and animal injury. The purpose is to show where improved methods and further research are needed and perhaps to prompt more critical interpretation of atmospheric analysis data. The deficiencies mentioned are generally recognized, but in the desire to obtain a rapid solution to a problem they are sometimes overlooked. This frequently adds to the confusion rather than helping to clarify the situation. Consideration has been limited to fluoride, photochemical air pollutants, and sulfur dioxide. (Author)

00260

J. M. Ross, R. H. Wade, and H. M. Benedict

A RAPID FIELD METHOD FOR DETERMINATION OF FLUORIDE IN PLANTS (FINAL REPT). Stanford Research Inst., South Pasadena, Southern California Labs. April 1963. 5 pp.

A colorimetric reaction, involving the ceriumIII-alizarin complexan reagent, is described for the simple semiquantitative determination of excess amounts of fluoride. A method is outlined that may be used in the field for the determination of fluoride in plants in excess of 40 ppm. (Authors' abstract)

00264

R. H. Wade, J. M. Ross and H. M. Benedict

A METHOD FOR THE DETECTION AND ISOLATION OF TRACES OF ORGANIC FLUORINE COMPOUNDS IN PLANTS. (FINAL REPT.) Stanford Research Inst., South Pasadena, Calif., Southern California Labs. Apr. 1963. 20 pp.

A method for the detection and isolation of submicrogram quantities of organic fluorine compounds from plant materials in the presence of much larger amounts of inorganic fluoride is presented. The procedure consists first of a rapid screening step for use with large numbers of vegetable samples and extracts and, second, of a chromatographic step to isolate and characterize any fluoro-organics found. These methods are developed in light of specific chemical characteristics of organic fluorine compounds as a general class. A modification of Soep's quantitative submicro fluoride analytical method is presented as applicable to these isolation methods. Microgram quantities of organic fluorine compounds were found in the plant materials investigated but at a level too low for isolation and identification. (Authors' abstract)

00450

E. Zawadzka, K. Pampuch-Karska

(DETERMINATION OF INORGANIC FLUORINE COMPOUNDS IN AIR.) Oznaczanie Nieorganicznych Zwiazkow Fluoru W Powietrzu. Chem. Anal. (Warsaw) 11(2):261-72, 1966. Text in Polish

The thiocyanate method of determination of fluoride ion in air and the zirconium-alizarin method based on the Bumsted reagent were compared. Influence of accompanying substances has been established on the results of analyses performed by the two methods. From the point of view of a toxicologist analyzing a workenvironment, both methods are sufficiently accurate when no interfering substances are present. However, the zirconium- alizarin method is much more sensitive and more specific than the thiocyanate method. Both methods are equally simple. The precision of the determinations carried out by the zirconium- alizarin method was 4% and the sensitivity of the method allowed detection of 5 micrograms of fluorine in a sample. In the case of dust samples containing 80 - 200 micrograms of fluorine, the precision of the determinations was 5%.

00626

L. H. Weinstein, R. H. Mandl, D. C. McCune, J. S. Jacobson, and A. E. Hitchcock

A SEMI-AUTOMATED METHOD FOR THE DETERMINATION OF FLUORINE IN AIR AND PLANT TISSUES. Contrib. Boyce Thompson Inst. Vol. 22(4):207-220, Dec. 1963.

A semi-automated procedure for the analysis of fluroine in air and plant tissue samples has been developed, based upon the use of the Technicon AutoAnalyzer. Ashed and alkali-fused plant tissue samples are suspended in 25 ml. of water in test tubes and are placed in a large sampler. An aliquot of the sample is automatically pumped into the heated revolving glass helix of a Digestor unit along with 50% H_2SO_4. As the acid-digest mixture passes through the helix, fluoride and water vapor are evolved and are continuously swept from the helix under reduced pressure, pass through a long glass funnel, through a water jacketed condensing coil, and into an impinger. The fluoride sample is continuously pumped from the bottom of the impinger and joins with a stream of lanthanum-alizarin complexone reagent. The mixture then passes through 4 double mixing coils where complete mixing and color development take place. The sample stream then flows to the colorimeter where the absorbency of the solution is measured at 624 millimicron. The impulse is transmitted to a recorder, and a peak is plotted. Absorbency of the peak is proportonal to fluorine concentration in the range from 0.10 to 3.2 microgram per ml. of original digest. With a slight modification, air samples, impinged in water, may be directly between the semi-automated and standard distillation methods. In the case of tissue digests, the rate of analysis is 12 per hour, while in the case of air samples, it is 10 samples per hour. (Author summary)

00636

R. H. Mandl, L. H. Weinstein, J. S. Jacobson, D. C. McCune, and A. E. Hitchcock

SIMPLIFIED SEMI-AUTOMATED ANALYSIS OF FLUORIDE. Preprint. 1966.

A microdistillation device is described which replaces the Digestor module in the Technicon AutoAnalyzer for analysis of fluoride. The unit offers the advantages of speed, good

reproducibility, and versatility. The potential use of this microdistillation unit in automated systems is described. (Author summary)

00941

J. S. Jacobson, D. C. McCune, L. H. Weinstein, and A. E. Hitchcock

STUDIES ON THE MEASUREMENT OF FLUORIDE IN AIR AND PLANT TISSUES BY THE WILLARD-WINTER AND SEMI-AUTOMATED METHODS. J. Air Pollution Control Assoc. 16(7):367-371, July 1966. (Presented at the 58th Annual Meeting, Air Pollution Control Association, Toronto, Canada, June 20-24, 1965, Paper No. 65-38.)

Determinations of F in plant tissues by the Willard-Winter (WW) and semi-automated (SA) methods have been studied for the presence of determinate and indeterminate errors by multiple linear regression analysis. The results have provided a better understanding of the magnitude of differences between tissue samples required for statistical significance and have suggested that the errors involved are much greater both in number and magnitude than usually assumed. The results have also established that the SA method is a satisfactory alternative to the WW method for determining the F content of plant tissues. Investigations of the sources of error in F determinations by the semi-automated method were carried out, and the results indicated a number of ways of reducing errors. Determinations of the F content of air by three methods were compared and studied to estimate the magnitude and locate the sources of error. Here, too, the results indicated that present estimates of the reliability of determinations of the F content of air may be overrated, and they have suggested that improvement in the mean of collection of HF is the best way of improving reproducibility. (Author summary)

01313

J.O. Ivie, L.F. Zielenski, M.D. Thomas, C.R. Thompson

ATMOSPHERIC FLUOROMETRIC FLUORIDE ANALYZER. J. Air Pollution Control Assoc., Vol. 15(5):195-197, May 1965.

A fluoride analyzer originally designed by Wiggins, St. John, Thomas and associates at Stanford Research Institute, has been modified to improve its operational capabilities and reliability so as to operate for periods in excess of six months with virtually maintenance. It measures hydrogen fluoride in the atmosphere in the sub-parts per billion range. The need for the instrument, method of measuring fluoride and the modifications made to improve the SRI instrument are presented. The instrument has been operated in the field for two years beside impingers which obtain daily integrated samples. The impinger samples are subsequently titrated. Satisfactory correlation has been found between the average daily values by the automatic analyzer and the impinger. (Author abstract)

01349

C. R. Thompson and J. O. Ivie

METHODS FOR REDUCING OZONE AND/OR INTRODUCING CONTROLLED LEVELS OF HYDROGEN FLUORIDE INTO AIRSTREAMS. Intern. J. Air Water Pollution (London), Vol. 9:799-805, Dec. 1965.

Methods and equipment are described for reducing ozone in an atmosphere by the addition of metered levels of nitric oxide. The NO is diluted with 50 vol of nitrogen before addition to the ozone containing airstream to prevent premature oxidant of NO to NO2 by oxygen of the air. Simple, reliable dispensing equipment for metering hydrogen fluoride into airstreams at the fractions of micrograms per cubic meter level is also described. This utilizes the constant vapor pressure of HF at O C from a relatively concentrated HF solution and variable levels of dispensing are achieved by varying the rate at which air is bubbled through the solution. An automatic valve system is described for providing a 24-hr present schedule of dispensing HF. (Author abstract)

01593

METHODS OF MEASURING AIR POLLUTION (¼REPORT OF THE WORKING PARTY ON METHODS OF MEASURING AIR POLLUTION AND SURVEY TECHNIQUES). Organisation and Development, Paris, France, Directorate for Scientific Affairs. 1965. 94 pp.

Methods for the measurement of the amounts of the following pollutants in the atmosphere out of doors using relatively simple and inexpensive apparatus were examined: grit and dust - particles coarse enough to settle out under their own weight; suspended matter - particles or droplets fine enough to remain suspended in the air; sulphur oxides; hydrocarbons; and fluorine compounds.

01793

F.N. Mortenson, H.M. Benedict, L.G. Transtrum, W.S. Winters

METHOD FOR DETERMINING FLUORINE INTAKE OF DAIRY COWS UNDER FIELD CONDITIONS. J. Dairy Sci. 45, (1) 74-8, Jan. 1962.

This field method enables an investigator to determine if the fluorine intake of a herd is within safe limits for dairy cows. It consists of determining average weights by heart-girth measurements, average milk production, and consumption of hay, concentrates, and silage from Dairy Herd Improvement Association records, or by weighing at the farm. Pasture Consumption is calculated by difference between the total digestible nutrients required and those supplied by other feeds. Water intake is based on Morrison's standard. The fluorine content of feeds and water is determined, and the amount of fluorine ingested is calculated in milligrams per kilogram of body weight. It is possible to determine fluorine ingestion for cows within a accuracy of plus or minus 20% at the 95% confidence limits. During 5 yr., 321 fluorine determinations were made in 60 herds. (Author summary)

02042

P. Bourbon

(ANALYTICAL PROBLEMS POSED BY POLLUTION BY FLUORINE COMPOUNDS.) Probleme Analytique du Dosage de l'Ion Fluor. Proc. (Part I) Intern. Clean Air Cong., London, 1966. (Paper VI/6). (Also published in J. Air Pollution Control Assoc. 17, (10) 661-3, Oct. 1967.)

The author sets forth the analytical problems posed by fluoride pollution and makes a critical study of the methods which are being used. The results that have been discovered over several years are reported. (Author abstract)

02565

S.N. Suvorova, A.M. Vorob'Ev, G.V. Rabovskii

EXPRESS METHOD FOR ELEMENTAL FLUORINE DETERMINATION IN THE AIR. (Ekspress-metod opredeleniya elementarnogo ftora v vozdukhe.) Hyg. Sanit. 29, (1) 80-2, Jan. 1964. CFSTI: TT65-50023/1

For purposes of the express analysis under field conditions particular note should be made of the reaction of fluorine with

potassium bromide and the subsequent reaction of the free bromine with fluorescein, which produces tetrabromofluorescein (eosin). The reaction is carried out on a solid adsorbent - silica gel - which is thereby colored red and compared with an artificially prepared scale of standards. Data on the fluorine determination by the express method and by the iodometric method are shown. Ten experiments were performed with all these concentrations, and in all cases the sampling rate was 5l/min. The sampling time was chosen in accordance with the fluorine concentration. The maximum error in fluorine determination by the express method is 10-12.5%.

02681

E. Lahmann

METHODS FOR MEASURING GASEOUS AIR POLLUTIONS. Staub (English TRANSLATION) 25, (9) 17-22, SEPT. 1965. CFSTI TT 66-51040/9

As the analysis of air pollutants has become a very extensive area of microchemistry, the statements included herein are limited to the principles involved in the analysis of the most important extraneous gases. Empirical, batch and continuous methods are the basic means for investigating gaseous air pollutants. The advantages and disadvantages of these methods are presented. Subsequently, the most important methods used at present for determination of sulfur dioxide, nitrogen dioxide, hydrogen sulfide, fluorides, oxidants, carbon monoxide and hydrocarbons are discussed.

03119

S.R. Craxford

STANDARDISATION OF MEASURING AND CONTROL APPARATUS AND OF METHODS OF MEASURING. European Conf. on Air Pollution, Strasbourg, 1964. p. 139-146.

From its study of the methods of measurement of air pollutants the OECD Working Party found that the methods adopted on an international basis fit into 3 categories: (1) well established methods suitable for international standardization; (2) methods considered to be of interim nature; (3) methods of known limited application. In general, the sampling procedures are considered to be as important as the analytical in measuring atmospheric air pollutants. The relative importance of air pollutants as revealed from study of national reports remains, since 1957, dusts, or deposited material, smoke, or suspended particulate material, and SO2. Sulfuric acid and other sulfates, oxides of nitrogen and carbon monoxide, compounds of fluorine and ammonia come next in importance. Greater emphasis in CO concentrations and the affects on health reflects greater concern with automotive emissions. Also, there is growing concern about the effects of polynuclear aromatic compounds which are present in the atmosphere, and of which there are many known carcinogens. Various standard analytical procedures are discussed briefly.

03478

C. W. Chang and C. R. Thompson

AN IMPROVED DIFFUSION METHOD FOR DETERMINING SUBMICROGRAM AMOUNTS OF FLUORIDE IN BIOLOGICAL SAMPLES. Microchem. J. 8, (4) 407-14, 1964.

A method for fluoride determination has been developed in which a level of 0.0-2.5 microgram fluoride was determined quantitatively from several milligram samples of biological material. This technique allows the drying, ashing, and diffusion of small samples without transfer. The SPADNS-zirconium lake is a sensitive and convenient color reagent. Recoveries of 96 to 102% were obtained.

03503

L. H. Weinstein, J. S. Jacobson, and R. H. Mandl

PROPOSED METHOD FOR SEMI-AUTOMATED ANALYSIS OF FLUORIDE IN PLANT TISSUES. Boyce Thompson Inst. for Plant Research, Inc., Yonkers, N.Y. 1966. 37 pp.

The method described involves dried and ground plant material which is ashed, alkali-fused, and diluted with water to a volume of 25 ml. The suspended digest and sulfuric acid are pumped into the Teflon coil of a microdistillation device maintained at 170 C. A stream of air carries the acidified sample swiftly through a coil of Teflon tubing to a fractionation column. The fluoride and water vapor distilled from the sample are swept up the fractionation column into a condenser, and the condensate passes into a small collector. The distillate is pumped continuously from the sample collector. Acid and solids are removed from the bottom of the fractionation column and are drawn to waste. The distillate is mixed continuously with alizarin fluorine blue-lanthanum reagent, and the colored stream passes through a 15-mm. tubular flow cell of a colorimeter, and the absorbance is measured at 624 millimicrons. The impulse is transmitted to a recorder. All major pieces of apparatus, with the exception of the microdistillation device, are components of the Technicon AutoAnalyzer.

03527

R. O. McCaldin

EVALUATING AIR POLLUTION PROBLEMS (ACCEPTABLE EQUIPMENT AND PROCEDURES). Arch. Environ. Health 2, 228-33, Mar. 1961.

Some of the more common equipment used in making environmental air quality determination, such as Hi-Volume Samplers, Filter Tape Samplers, Gas Samplers, and simplified monitoring techniques, are discussed. Hi-Volume Samplers are frequently used to measure suspended particulate which may consist of smoke, dust, or other solids small enough to remain air-borne for long periods. This includes particulates under 100 microns in diam, and, for the most part, those less than 1 micron in diam. Fiber glass filters commonly used with this sampler collect practically all particulates down to 0.3 micron in diam. The sampler itself consists of a vacuum cleaner motor with mounting to accomodate an 8-in by 10-in filter. Filter Tape Samplers are commonly used in the field studies and usually are equipped with a diaphragm pump to draw air through at a rate of about 7 liters/min. Various automatic instruments are used for the continous collection and recording of gaseous pollutants. However, various manual or semimanually operated bubbler collection trains have been used in the majority of gaseous measurements. Simplified monitoring techniques are discussed in conjunction with dustfall sulfation rates, H2S, corrosion and fluoride sampling.

03550

D. F. Adams and R. K. Koppe.

A FIELD EVALUATION OF THE MINI-ADAK III AUTOMATIC, FLUORIDE AIR POLLUTANT ANALYZER. J. Air Pollution Control Assoc. 12, (4) 164-9, Apr. 1962 (Presented at the 54th Annual Meeting, Air Pollution Control Association, New York City, June 11-15, 1962.)

This study has shown that short-term fluctuations in the concentration of fluorides in the atmosphere can be recorded by the use of the Mini-Adak II analyzer, an automatic flow colorimeter embodying an air-reagent contacting cell. The data furthermore showed the comparability of the long-term average atmospheric fluoride concentrations as determined with automatic instrumentation and conventional manual methods. Simultaneous sampling with two Mini-Adak II

analyzers and two sequential samplers showed that data provided by the automatic instruments varied less than similar data from the two sequential samplers. Limed filter paper data obtained simultaneously at one sampling site predicted a somewhat lower, but explainable, 30-day average atmospheric fluoride concentration than was experimentally determined by instrumentation and sequential sampling. Selective sampling of the gaseous or particulate fluoride in the atmosphere showed that (a) approximately 87% of the particulate fluorides (retained on type AA Millipore filters) were recorded by the Mini-Adak II analyzer and (b) the average ratio of particulate/gaseous fluorides in the area of study was 1.5.

03908

Y. Yoshida

EXPERIMENTAL STUDIES ON CHRONIC FLUORINE POISONING. II. METHODS OF MICRODETERMINATION OF FLUORINE. Japan J. Ind. Health (Tokyo) 1, (7-8) 97-105, Nov. 1959. Text in Japanese.

A study was carried out to determine the microquantity of fluorine in chronic fluorine poisoning. Both bleaching colorimetry of Th-Alizarin and photoelectro-colorimetric titration were improved and the conditions for increasing the accuracy were determined. This method was based on the reaction of the Fluoride ion with Th-Alizarin lake, utilizing the phenomenon which quantitatively changed with the density of the lake by letting F- form a colorless complexion with +4 Thorium ion. The method used was considered appropriate for determination of microquantity of fluorine. The results obtained are as follows: () Titration is suitable as a routine method since the quantity examination line becomes straight. 2) With both methods, measurement will be possible down to 0.1 gamma/25 ml (0.004 ppm). 3) Over the range fluoride ion 0 to 20 gamma/25 ml, repeatability is possible to 95 to 105%. 4) Measurement should be undertaken exactly five minutes after the coloring of the lake. 5) Hydrogen ion concentration greatly affects the accuracy and precision, and this measurement should be taken at exactly pH 3.00. 6) In photoelectrocolorimetric titration, the endpoint was fixed at E 0.080 for improving precision. 7) The extent of the effect of interfering ions was small in Cl, Ca and NH4 ions, medium in Mg, SO4, and extremely high in Al and HPO4 ions.

04038

M. R. Pack, A. C. Hill, and H. M. Benedict

SAMPLING ATMOSPHERIC FLUORIDES WITH GLASS FIBER FILTERS. J. Air Pollution Control Assoc. 13, (8) 374-7, Aug. 1963.

Glass fiber filters with uniformly low fluoride blanks compared well with impingers for sampling gaseous and particulate fluorides in the various atmospheres. The filters offer a simple and convenient means of collecting total atmospheric fluorides at a minimum cost for equipment and maintenance. Although the only limitation on the size of sample is that enough fluoride be collected for accurate determination, the method described is especially adapted to collecting samples covering 24 or longer. Samplers can be operated for at least a week at most locations without attention. This is frequently adequate for monitoring purposes. Shorter sampling intervals are necessary to establish the extent of short-time fluctuations. The filters showed a tendency to give slightly lower concentrations than impingers when sampling hydrogen fluoride and slightly higher concentrations when particulate fluoride predominated, but the differences were not statistically significant. Care should be exercised in selecting glass fiber filter media for fluoride sampling, however, because wide differences were found in the magnitude and variability of fluoride blanks of different media tested. The use of an aluminum tube apparatus preceding the glass fiber filters offers a means of separating gaseous and particulate forms of fluoride, that is the most satisfactory of several methods previously tested by the authors. Protection from moisture is essential for proper operation of either the glass fiber filter samplers or the aluminum tube apparatus, but the protection provided must not prevent fluoride from reaching the samplers. The shelters tested did not affect results, and the aluminum tube apparatus worked just as well with the open end down.

04105

S. N. Suvorova, A. M. Vorob'Ev, and G. V. Rabovskii

FLUORINE AND HYDROGEN FLUORIDE DETERMINATION IN THE AIR WITH A SOLID SORBENT. Gigiena i Sanit. 28, (10) 48-50, Oct. 1963. Russ. (Tr.) (Translated by B. S. Levine in U.S.S.R. Literature on Air Pollution and Related Occupational Disease, Vol. 12.) CFSTI: TT 66 61429

No simple and adequately sensitive methods have been described for the determination of fluorine and hydrogen fluoride. Therefore, the first step in this investigation was to select a substance which might completely absorb both components. After some preliminary tests the following absorber solution was selected; Na2S203-7, KI-4, and methyl (p-methylaminophenol sulfate) 0.1 per cent by weight. However, successive determinations of the fluorine-ion in this absorber mixture by highly sensitive procedures proved very complicated. For this reason, the present authors decided to use solid absorbers. The first absorber thus tested was silicagel trademarked MSK of granule sizes ranging between 260 and 300 mg, which were impregnated with an aqueous solution of triethanolamine. Best results were obtained with 2 g of the silicagel in a Yavorov or in a U-shaped tube. Fluorine determinations were made colorimetrically by the thorium-thoron method after it had been extracted from the silicagel.

04405

O. Cucchiara, R. Rex, T. Donaghue

THE DEVELOPMENT OF AN INSTRUMENT FOR THE DETECTION OF HAZARDOUS VAPORS. Parametrics, Inc., Waltham, Mass. (Technical Rept. No. AFAPL-TR-65-50.) June 1965. 54 pp. DDC, AD 465094

A prototype model of an instrument which is capable of detecting low concentrations of hydrogen, fluorine and fluorine-containing oxidizers was developed. The instrument provides an audible alarm within three to five seconds after exposure to near hazardous concentrations of these gases. The alarm concentrations are either 0.5% or 1.0% hydrogen, and .025 ppm of fluorine, chlorine trifluoride or oxygen difluoride. Other detection levels (both higher and lower) could be set if required. The basis of this technique is that the loss of radioactivity of a kryptonated homolog upon reaction with a gas is proportional to the concentration of the reacting gas. The instrument is portable, simple to operate, and reiable. The instrument incorporates the technique of radiochemical exchange using kryptonates. Selectivity is achieved by the utilization of different kryptonated sources for the various gases. Other gases can be detected with this instrument by using appropriate kryptonate homologs. (Author abstract)

04458

J. L. Fergason, N. N. Goldberg, C. H. Jones, R. S. Rush, L. C. Scala, and F. Davis

DETECTION OF LIQUID CRYSTAL GASES (REACTIVE MATERIALS). Westinghouse Electric Corp., Pittsburgh, Pa., Research Labs. (Technical Rept. No. RADC-TR-64-569.) Aug. 1965. 127 pp. DDC, AD 620 940

The purpose was to determine whether reactive liquid crystals could be developed that would detect 1 to 10 ppm of certain gases. Satisfactory materials were produced to detect hydrazine hydrate (HH),unsymmetrical dimethylhydrazine (UDMH),NO2,HNO3, HF, and HCl. With the exception of HCl and HF, all of the gases could be readily distinguished from one another. Temperature- sensitive detectors were developed which are capable of distinguishing between HH and UDMH at concentrations of 8 ppm. A number of detectors were developed that respond to the oxides of nitrogen, and detection of 6 ppm of NO2 was satisfactorily achieved. N2O, which is relatively inert, was found not to react with any of the systems studied. When oxides of nitrogen are present in an atmosphere that contains any water vapor, HNO3 will be formed. Materials that detected 1 ppm of HNO3 were prepared and tested. Two detectors were developed that will detect HCL and HF at concentrations below 1 ppm. However, no simple method for distinguishing between the two was found. The set of reactive cholesteric liquid crystals exhibit a change in color transition temperature upon exposure to the contaminants.

04463

D. E. Harrington and R. S. Dorsett

DETERMINATION OF FLUORIDE BY PYROHYDROLYSIS AND AUTOMATED COLORIMETRY. Du Pont (E.I.) De Nemours & Co., Aiken, S. C., Savannah River Lab. (Rept. DP-1004.) Dec. 1965. 15 pp. CFSTI, DP-1004

A pyrohydrolytic-colorimetric method was developed for the determination of fluoride in the presence of high concentrations of interfering elements. Adaption of the colorimetric reaction of fluoride with the lanthanum chelate of alizarin complexone to an automated system gave a minimum detectable limit of 0.050 microgram/ml of fluoride in pure solutions and 25 microgram of total fluoride in samples that required the pyrohydrolytic separation from interferences. The relative standard deviation of the method is better than 1% at twenty times the limit of detection. (Author abstract)

04540

M. R. Pack and A. C. Hill

FURTHER EVALUATION OF GLASS FIBER FILTERS FOR SAMPLING HYDROGEN FLUROIDE. J. Air Pollution Control Assoc. 15, (4) 166-7, Apr. 1965.

Tests were conducted to determine the limitations of glass fiber filters in sampling atmospheric hydrogen fluoride. The tests were conducted in a plastic chamber receiving a continuous supply of clean air with HF added. Sets of three two-inch filter discs were used, one behind another in common open-faced holder. Samples were drawn through the filters at about 1.3 cfm for periods of one, two and three days. Tests were made at several different atmospheric fluoride concentrations ranging from 2 to 25 microgram/cu m. Filters with and without latex binder (MSA-CT77225 and MSA-CT77332 respectively) were evaluated simultaneously. Filters without latex binder were more efficient collectors than those with binder. Up to 75 microgram F/sq in. of filter area was collected by a single filter before the loss reached 5%. Two filters, one behind the other, collected over 250 micrograms F sq in. of filter area before loss through them reached 5%. By controlling the sampling rate and time to avoid exceeding the saturation limit, it is possible to use glass fiber filters for sampling over a wide range of fluoride concentrations.

04685

R. Mavrodineanu J. Gwirtsman

EFFECT OF VOLTAGE VARIATION ON THE PHOTOMETRIC TITRATION OF FLUORIDES WITH THORIUM NITRATE. Contrib. Boyce Thompson Inst. 19, (3) 289-90, Mar. 1958.

The photoelectric filter photometer used for the titration of fluorides (F) with thorium nitrate (TH(NO3)4) is of the balanced type and makes use of two photocells connected in opposition to a sensitive galvanometer. The light bulb of this photometer is connected directly to the 115-v. electric line without any voltage stabilizer. In order to determine the effect of voltage variation, a series of tests was carried out with known amounts of F titrated with Th(NO3)4 at five different voltages (90, 100, 110, 120, and 130 v.). The variation in voltage during the determinations did not exceed more than 1%. A variation of 10% in voltage resulted in the following percentage decrease in the titration with 0.000IN Th (N03)4: 2% for 90 to 100 v.; 3.6% for 100 to 110 v.; 4% for 110 to 120 v.; and 6% for 120 to 130 v. Corresponding results with 0.0IN Th(NO3)4 were: 6% for 90 to 100 v.; 11% for 100 to 110v.; 13% for 110 to 120v.; and 5% for 120 to 130v. The 0.0IN Th(NO3)4 is generally used for titrating solutions containing more than 200 micrograms F. Titrations were carried out using a voltage stabilizer and the results obtained showed no improvement when compared with the titrations carried out without the voltage stabilizer. When the photoelectric titrator is used with a 0.00IN Th(NO3)4 solution and the voltage of the line varies within 5%, the instrument can be used without a stabilizer. If the voltage varies over 5%, a voltage stabilizer is recommended, especially if the 0.0IN Th(NO3)4 solution is used.

04686

R. Mavrodineau and J. Gwirtsman

IMPROVED APPARATUS FOR THE DISTILLATION OF FLUORINE AS HYDROFLUOSILICIC ACID. Contrib. Boyce Thompson Inst. 17, (8) 489-94, Sept. 1954.

A new type of steam distilling apparatus for the distillation of fluorine as hydrofluosilic acid is described. It is composed of a steam generator made from a 1500-ml flask provided with a safety tube and an outlet which can be closed by a Hofman clamp. A ground glass joint connects a steam generator with the distilling flask. A second joint connects the latter to a Friedrich type condenser. The distilling flask is made from a Pyrex cylinder through which a thermometer passes and dips into the solution. An electric jacket keeps the temperature of the distilling liquid at 135 plus or - 2 C. A multiple distilling apparatus of six units is described. It takes about 75 min. for the collection of 500 ml of distillate, low distilling blanks, good recovery (98 to 101%), and automatic efficient washing.

04687

R. Mavrodineanu and R. R. Coe

IMPROVED APPARATUS AND PROCEDURES FOR SAMPLING AND ANALYZING AIR FOR FLUORIDES. Contrib. Boyce Thompson Inst. 18, (3) 173-80, June 1955.

Descriptions are given of improved apparatus and procedures for sampling and analyzinf air containing hydrofluoric acid

(HF) and silicon tetrafluoride (SiF4) gases in concentrations of less than one to several hundred parts per billion of air. A closed type conical-shaped absorber of 500-ml. capacity containing 50 ml. of absorbing solution proved efficient (95% recovery of the fluorine (F) for absorbing fluorides from air passed through the absorber at rates up to 70 cu. ft. per hr. A smaller absorber (300 ml.) of similar design containing 40 ml. of absorbing solution was equally efficient with air speeds up to 40 cu. ft. per hr. and, when converted into a distilling unit without transferring the sample, gave 95% recovery of F and an average blank of 1 microgram F. Both absorbers are easy to wash and are less subject to contamination than conventional types previously used. A description is also given of an automatic time-clock sampling unit together with details of the back titration procedure used in fluorine analysis. Recent results indicate that direct titration of the sample with thorium nitrate and determination of the end point by means of a specially designed filter photometer constitute a much faster, more sensitive, and more precise method than visual titration with sodium fluoride (NaF). (Author summary modified)

04689

R. Mavrodineanu J. Gwirtsman

PHOTOELECTRIC END-POINT DETERMINATION IN THE TITRATION OF FLUORIDES WITH THORIUM NITRATE. Contrib. Boyce Thompson Inst. 18, (3) 181-6, June 1955.

The procedure used in this laboratory for the determination of fluorides in plant tissue and in air is based on the Willard and Winter method. In this method the fluoride is isolated in the form of fluosilicic acid after a perchloric acid steam distillation at 135 C. A description is given of a photoelectric filter photometer functioning as a comparator for the determination of the end point in the titration of fluorides (F) with thorium nitrate (Th(NO3)4) in the presence of sodium alizarinsulfonate. It is a balance type instrument consisting of a nearly monochromatic light source, two glass cells for the solutions, and two barrier-layer photoelectric cells connected in opposition. A mirror galvanometer mounted in parallel acts as a zero indicator. The instrument is directly supplied by the 115-volt line and is stable and sensitive. Its use makes possible the titration of 1 microgram F in 250 ml. of solution, one determination requiring 10 minutes. When equipped with adequate supplementary parts it can also be used for the transmission measurements of colored solutions as well as a nephelometer or fluorometer. (Author summary modified)

04690

R. Mavrodineanu

A SIMPLE METHOD FOR THE DETECTION OF VOLATILE FLUORIDES IN AIR. Contrib. Boyce Thompson Inst. 18, (1) 82-4, Dec. 1954.

The method commonly used for determining gaseous fluorides at concentrations as low as one ppb or less air requires the use of special equipment and procedures. The present method utilizes dry sampling with a strip of blotting paper impregnated with a suitable reagent, that reacts with hydrogen fluoride (HF) and other volatile fluorides which are readily convertible into HF, such as silicon tetrafluoride (SiF4) and fluosilicic acid (H2SiF6). The degree of bleaching is a function of the concentration of the gas and the duration of exposure. The procedure for impregnation of the paper is as follows: strips of white blotting paper of 0.5-mn. thickness and convenient size are immersed in a solution of thorium nitrate. After draining, they are immersed in a solution of sodium alizarinsulfonate. A rose-colored lake will form on the paper surface. After a short rinsing in distilled water, the paper is dried. The prepared strips, protected from rain, are hung in the desired locations for the detection of atmospheric fluorides, Half of the surface of the strip is covered with a thin vinyl film in order to provide a control. After the absorbing medium (strips) has been exposed for a given time, it is developed by immersion in a 1/100 N Hcl solution and the vinyl film taken off. Any bleaching that occurs on the exposed part, as compared with the control, constitutes a proof of the presence of volatile fluoride (as HF, H2SiF6, SiF4, etc.) in the area. Fluoride concentration in unknown atmospheres may not only be detected but also approximately evaluated by standardizing the sensitive paper exposed for a given time in atmospheres of known fluoride concentration.

04691

P. Mavrodineanu, J. Gwirtsman, D. C. McCune, and C. A. Porter

SUMMARY OF PROCEDURES USED IN THE CONTROLLED FUMIGATION OF PLANTS WITH VOLATILE FLUORIDES AND IN THE DETERMINATION OF FLUORIDES IN AIR, WATER, AND PLANT TISSUES. Contrib. Boyce Thompson Inst. 21, (8) 453-64, Sept. 1962.

Investigations at Boyce Thompson Institute on the effects of atmospheric fluorides on vegetation necessitated the development of procedures for the controlled fumigation of plants and for the analytical determination of fluorides in plant material, water, and air. These procedures were published as they were developed and modified over a period of several years. This paper summarizes the procedures currently employed and gathers in one place the references to the detailed technical papers necessary to reproduce them.

04692

R. Mavrodineanu and J. Gwirtsman

USE OF SODIUM PEROXIDE FUSION FOR THE DETERMINATION OF FLUORIDES IN VEGETATION. Contrib. Boyce Thompson Inst. 18, (9) 419-20, Dec. 1956.

The procedure for analyzing fluorine in vegetation has been improved in recent years by the development of a new steam-distilling apparatus with electric heating and the use of photoelectric end-point determination in the titration of fluorides with thorium nitrate. In an effort to shorten the time required for the conversion of insoluble fluorine compounds into a soluble ionizable form, a direct fusion of the plant material with sodium peroxide (Na2O2) was carried out in a Parr bomb. The results showed that the average time required to complete a direct Na2O2 fusion is 30 minutes as compared with 6 hours necessary for the ashing with CaO used in the standard procedure. Both potassium nitrate and potassium perchlorate are recommened for the accelerator, the latter being preferable, particularly if the nitrate content of the sample is high.

04757

J. Gwirtsman, R. Mavrodineanu, R. R. Coe

DETERMINATION OF FLUORIDES IN PLANT TISSUES, AIR, AND WATER. Anal. Chem. 29, (6) 887-92, June 1957.

Special equipment was developed and analytical procedures were adapted for determination of fluorides in vegetation, air, and water, in order to study the effect of volatile fluorides on vegetation. The equipment includes a steam-distilling apparatus with a complete electric heating system, two types of absorbers for air analyses, one of which also functions as a steam-distilling flask, and a photoelectric filter photometer for titration of fluorides with thorium nitrate. The main advantages are

low blanks, fast distillation, quantitative recovery, safe operation, and convenient and efficient washing. Consideration was given to sampling of plant material and effect of silica on the determination of fluorides in vegetation. Results of a cooperative analytical project involving 15 different laboratoroes are included.

05078

E. R. Kuczynski

EFFECTS OF GASEOUS AIR POLLUTANTS ON THE RESPONSE OF THE THOMAS SO 2 AUTOMETER. Environ. Sci. Technol. 1, (1) 68-73, Jan. 1967.

A study was made of the quantitative response of the Thomas SO2 autometer to gases that might coexist with SO2 as air pollutants. These gases included NO2, NO, HC1, CL2, NH3 , and HF. The gas mixtures were prepared dynamically at the ppm level by a flow mexing method to a high degree of accuracy. Syringe pumps were used to add small quantities of pure gases to a large vol. air stream. The effects of NO2, NO, and HF on the SO2 reading were small, but HC1, NH3, and CL2 gave significant response. (Author abstract)

05317

Dorsey, James A. and Douglas A. Kemnitz

A SOURCE SAMPLING TECHNIQUE FOR PARTICULATE AND GASEOUS FLUORIDES. J. Air Pollution Control Assoc., 18(1):12-14, Jan. 1968. 7 refs. (Presented at the 60th Annual Meeting, Air Pollution Control Association, Cleveland, Ohio, June 11-16, 1967.)

Sampling of effluents that contain fluorides is often hampered by the reactivity of hydrogen fluoride. Although techniques have been developed for sampling ambient air, they are not applicable to stack effluents, which contain higher concentrations of fluoride, water, and particulates. A sampling system for the separation and collection of gaseous and particulate fluoride was devised and tested. In this system a heated glass probe serves as a reactor for converting hydrogen fluoride to silicon tetrafluoride before the particulate is filtered. Laboratory tests have demonstrated quantitative recoveries of hydrogen fluoride after the test mixtures pass through the probe and through filter papers impregnated with sodium bicarbonate. The equipment has performed satisfactorily in field sampling.

05439

METHODS OF MEASURING AIR POLLUTION (PART 6). Metodi di Misura dell' Inquinamento Atmosferico (Sesta Parte. Fumi Polveri (Milan) 1(7):18-24, Jan. 1967. It.

Two methods for measuring minute quantities of fluorine in the atmosphere are described. 1) Two methods are given for measuring a sample with an impinger. In the photometric method air is introduced in the appratus containing a normalized solution of 0.1 N NaOH which absorbs the fluorine ions. The ions are then separated in the vapor state and the amount of fluorine determined photometrically. The sensitivity of this method is 3 micrograms F/cu m of air when measured directly, and 0.6 microgram F/cu m when preliminary concentration measurements are made. The metric titration method, less sensitive than the photometric (10 micrograms F/cu m, is used for high fluorine concentrations. Equations are given for both photometric and titration methods from which the concentration of fluorine can be calculated. 2) In micro-diffusion methods, air is passed across a bottle containing gas and pieces of plexiglass on which compounds containing fluorine are absorbed in 0.1 N NaOH. Extraneous substances are eliminated by micro-diffusion and the amount of fluorine is determined photometrically.

05586

H. M. Benedict and W. H. Breen

THE USE OF WEEDS AS A MEANS OF EVALUATING VEGETATION DAMAGE CAUSED BY AIR POLLUTION. Proc. Natl. Air Pollution Symp., 3rd, Pasadena, Calif., 177-90 (1955)

This paper presents the results of fumigations of ten species of weeds which occur more or less commonly throughout the United States, by ammonia, chlorine, hydrogen fluoride, hydrogen sulfide, oxides of nitrogen, and sulfur dioxide. Plants of two different ages and growing under two conditions of available soil moisture were fumigated at two concentrations of each compound. The results are recorded as (1) descriptions and photographs of the markings which were produced on each weed by each fumigant; (2) relative resistance of the various weeds to each fumigant. By using these two types of information it is believed that, in an area where air pollution may be causing markings on vegetation, observation of the markings on some of these weeds will lead to identification of the pollutant and consequently determination of the area over which it is spreading in concentrations sufficiently high to mark vegetation. (Author summary)

05620

A. Zoerner

THE DETERMINATION OF LOW CONTENTS OF FLUORINE. (Die Ermittlung geringer Fluorgehalte.) Stahl Eisen (Duesseldorf) 87, (2) 95-7, Jan. 26, 1967. Ger.

Determination of small amounts of fluorine in air was investigated, in connection with control of air pollution, by cooperative testing of methods described in literature; method adopted, by which amounts to 1 microgram of fluorine are accurately determined, is described in detail.

05892

J. O. Ivie, M. D. Thomas, O. C. Taylor, C. R. Thompson, , W. M. Dugger, Jr., B. L. Richards

RECORDING THE RESPONSE OF PLANTS TO VARIOUS AIR POLLUTANTS. J. Air Pollution Control Assoc. 13 (8), 355-9 (Aug. 1963). (Presented at the 55th Annual Meeting, Air Pollution Control Association, Chicago, Ill., May 20-24, 1962.)

This paper is an outline of experimental procedures and instrument methods employed to measure effects of the air pollutants, fluorides, ozone, and peroxyacyl nitrates (PAN), on citrus trees. The plan calls for the operation of at least three experimental test sites on which 24 citrus trees in plastic enclosures are given six treatments as follows: A - 'Clean air,' B - 'Ambient air,' C - 'Fluoride-free' air, D - 'Ozone- free' air, E - 'Clean air' with fluoride added, and F - 'Fluoride and ozone free' air. Two test sites on lemon trees are in operation at Upland and Cucamonga, California. A third site on Naval orange trees is under construction at Upland, California. Photosynthesis and transpiration measurements are used to supplement long-term growth and yield observations. Inlet and outlet air samples are accumulated in bags for one-half hour periods. The difference in humidity and carbon dioxide is then measured sequentially from the air in the bags. Automatic punchcard recording is provided for plot samples and for the ambient air pollutants which consist of: dioxide, nitric oxide, ozone, total oxidants, and fluorides. These are recorded together with the date, time, temperature, and an integrated value for sunlight. Four IBM cards are punched each hour

with positive identification of the data sources both from the punch position and card reference number. Activated charcoal and limestone filters are used to remove oxidant and fluoride phytotoxicants, respectively, from the air entering the plots. The average concentration of fluoride occurring on one day is used to set the hydrogen fluoride concentration metered into the four plots receiving this treatment on the following day. Nitric oxide is diluted 1 to 50 with nidant level increases to react with and inactivate ozone as a phytotoxicant. Twice the stoichiometric amount of NO is used as the level of total oxidants, i.e., for 0.1 ppm total oxidant 0.2 ppm NO is added.

05914

Altshuller, Aubrey P. and Israel R. Cohen

WINDOW MATERIALS FOR USE IN INFRARED ANALYSES INVOLVING NITROGEN DIOXIDE. Anal. Chem., 31(4):628-629, April 1959. 11 refs.

Calcium fluoride, barium fluoride, and arsenic trisulfide crystals were tested as alternatives to sodium chloride crystals for use as infrared-transmitting materials in spectrophotometric devices designed for nitrogen dioxide determinations. The presence of 0.1% or more NO2 damages sodium chloride windows in gas cells on a single exposure. Each crystal was subjected to 0.17% NO2 in carbon tetrachloride for 4 days. Both barium fluoride and calcium fluoride crystals showed no change in surface appearance, whereas the arsenic trisulfide crystal became coated in an hour or less with a greenish yellow deposit at NO2 concentrations of 0.17% or 0.06%. Barium fluoride showed an additional 4 micron of transmittance range in comparison to calcium fluoride, making it more attractive as a window material in infrared spectrophotometers designed for NO2 measurements.

06112

Tada, O.

MEASUREMENT OF AIR POLLUTANTS.Bunseki Kagaku (Japan Analyst) (Tokyo) pp. 110R-7R. 1966. Jap.

Important papers published in Japan Analyst in 1964 and 1965 are summarized. The subject is limited to measurement methods of air pollutants known to be toxic to health. Pollutants from stacks and automobile exhausts are covered, including many cyclic hydrocarbons, aldehydes, sulfur oxides, nitrogen oxides, ozone, carbon monoxide, carbon dioxide, fluorine compounds, hydrogen sulfide, lead compounds, and offensive odors. Various sampling methods are described, especially using filtering with glass wool filters, electric dust collectors, gas absorbers, and portable samplers containing silica gel. The pollutants can be measured by electroconductivity methods, colorimetric measurement recorder, gas chromatographic analysis, electron capturing detector, and hydrogen ion detector. The papers summarized do not include those dealing with industrial or occupational environment or mining.

06279

K. E. Ball

DEVELOPMENT OF AN ATMOSPHERIC MONITORING SYSTEM (FINAL REPT. JUNE 12, 1958-JUNE 30, 1961). (Mine Safety Appliances Co., Pittsburgh, Pa., Research and Engineering Division.) (1961). 45 pp. (Rept. No. MSA 301825.)

Atmospheric monitoring devices sensitized to continuously detect and record toxic and higher concentrations of HF, F2, B5H9, N2H4, NO2 and C1F3 (missile fuels and oxidizers) have been developed and engineered. An ionization type analyzer sensitive to finely divided aerosols is used as the detecting instrument. Various amine and acid reagents are used to convert the oxidizers and fuels respectively to aerosols. Response times are in the order of seconds and a high degree of specificity has been attained. (Author's abstract)

06338

Magna Corp., Anaheim, Calif., Research and Development Div. (Rept. RED-TDR-63-1136.) (May 1963). 48 pp.

TOXIC VAPOR INDICATORS. CFSTI, DDC: AD 607046

Results are presented of work performed in the development of thin film sensors for the detection of low concentrations of nitrogen tetroxide and fluorine. The effect of temperature and humidity on the response rates of the films is presented. Responses, in terms of increase in sensor resistance, of several percent per minute have been below 1 pmm. Based upon the results, a laboratory model of a personnel dosimeter for nitrogen tetroxide and fluorine was built and submitted for field tests. (Author abstract)

06352

R. P. DeGrazio and R. G. Auge

GAS CHROMATOGRAPHIC INVESTIGATIONS FOR THE DETERMINATION OF FLUORINE AND OXYGEN IN MIXTURES. Dow Chemical Co., Golden, Colo., Rocky Flats Div. (Rept. REP-880) (Apr. 12, 1967). 10 pp. CFSTI: RFP-880

This report describes various methods investigated for the determination of fluorine and oxygen in gas mixtures by gas chromatographic techniques. The technique found to be successful involves the quantitative conversion of fluorine to chlorine by the reaction with sodium chloride and the subsequent separation and detection of chlorine and oxygen. (Author abstract)

06397

Ivie, J. O., D. P. Barnes, and R. Allen

CONTINUOUS ANALYSIS OF GASEOUS FLUORIDES IN AMBIENT AIR AND ON INDUSTRIAL STACKS. Preprint. Air Pollution Control Assoc., Pittsburgh, Pa. (Presented at the Air Pollution Control Association Annual Meeting, 60th, Cleveland, June 11-16, 1967, Paper 67-75.)

Two sampling methods are discussed for full-range hydrogen fluoride sampling. For ambient use, the SRI fluorescent-quenching method is explained as the one that would reach a low sensitivity of 0.1 ppb. For the high-stack sampling range, an internal electrolysis instrument developed by Baker and Morrison for continuously monitoring fluoride emissions from industrial stacks is described. The tests indicate that the internal electrolysis method can be used effectively for stack fluoride emissions.

06398

Jacobson, J. S. and D. C. McCune

AN INTERLABORATORY STUDY OF FLUORINE IN VEGETATION. Preprint, Air Pollution Control Assoc., Pittsburgh, Pa. (Presented at the Air Pollution Control Association Annual Meeting, 60th, Cleveland, June 11-16, 1967, Paper 67-76.)

An interlaboratory study of fluorine analyses on plant tissues was performed to determine the current levels of within- and between- laboratory precision. Homogeneous, ground, fluorine-containing leaf tissues of alfalfa, citrus, gladiolus, pine, and orchard grass were analyzed by routine methods currently in use in 31 different laboratories. The study indicated that there are wide differences in results from laboratory to laboratory. The wide variations in procedures, techniques, and

operating conditions probably account for the relatively large standard deviations between laboratories which ranged from 12.7 to 38%. The results of duplicate determinations indicated that some laboratories have difficulty in obtaining reproducible results. Greater attention to detail, more careful performance of operations, increased use of check procedures, standardization of techniques, and development and use of referee samples would lead to increased agreement in results. (Author abstract)

06494

Nakamura, J. T. and K. E. Ball

ATMOSPHERIC MONITORING OF TOXIC LEVEL OF MISSILE PROPELLANTS. Am. Ind. Hyg. Assoc. J. 25(1):77-80, Feb. 1964.

The problem of toxicity in the over-all missile industry represents both the materials involved and the amassed quantities of these materials. Although most missile fuels and oxidizers are predictable in their behavior, the handling of these relatively common compounds in tonnage lots presents problems which have not been explored and therefore cause due concern. Spill tests, conducted at the Edwards Rocket Research Laboratories, releasing up to half-ton quantities of such propellants as fluorine, nitrogen tetroxide, hydrazine, UDMH, chlorine trifluoride, and pentaborane have been conducted. In some tests, fuels and oxidizers were spilled together. The purpose being to determine the magnitude of the hazard; that is, the aspects of explosion and fire as well as toxicity and pollution. The following are felt to be reasonable requirements for a tentative atmospheric monitoring arrangement: (1) accuracy plus or minus 25%, (2) range capable of at least two orders of magnitude, preferably more, (3) speed of Response 90% of final reading or more in less than 10 seconds, (4) specificity - the instrument need not be 100% specific for a particular fuel or oxidizer since in many cases there is little chance of any other material being in the vicinity. Common solvents, degreasing fluids, oil, gasoline and materials of this nature should not cause an interfering signal. A fuel concentration should not inhibit the response of incorporated into a detection system. These 'extras' might in- clude explosion-proof design, malfunction-indicating devices and elaborate centralized readout systems. For many application, a may provide adequate information. The choice specifications for a detection system should be governed by the specific problem involved and the type of information required. choice specifications for a detection system should be governed by detectors and spot-check devices. In a few applications, required.

06962

W. Leithe and G. Petschl

COMPARATIVE ABSORPTION TESTS FOR DETERMINATION OF GASEOUS AIR CONTAMINANTS IN WASH BOTTLES. (Vergleichende Absorption-sversuche zur Bestimmung gasformiger Luftverunreinigungen in Waschflaschen.) Z. Anal. Chem. 226 (4), 352-61 (1967). Ger.

Comparative gas-absorption tests are described using air contaminated with CO2, HCl, NH3% SO2, and air samples from production plants containing fluorides. The concentrations were in the range of the Maximum Allowable Concentrations and below. Three kinds of gas washing bottles have been employed: 1) Impinger washing bottles, recently recommended for air analyses; 2) ordinary Drechsel washing bottles; 3) washing bottles with porous glass discs containing a foam formation agent. The effect of the Impinger equalled that of the Drechsel type. With HCl, NH3, and SO2 there was no difference between Impinger and foam absorption bottle, but with CO2 and air samples containing fluorides foam absorption showed up to ten times higher absorption efficiencies. Corresponding analyses of open-air samples containing fluorides are being conducted. (Author summary)

06983

N. A. Poulos

AMPEROMETRIC PROPELLANT-COMPONENT DETECTOR. Olin Mathieson Chemical Corp., New Haven, Conn., Contract No. AF 33(600)-39311, Project No. 7165, Task No. 71386, ASD Technical Rept. No. 61-154, 39p., May 1961. 19 refs. CFSTI/DDC: AD 265614

The data obtained in production of an improved multipurpose detector capable of measuring low airborne concentrations of nitrogen tetroxide (N2O4), ozone (O3), hydrazine (N2H4), unsymmetrical dimethylhydrazine (UDMH), and hydrogen fluoride (HF) is presented. The concept of 'forward and reverse polarization' was applied and considerable specificity was obtained of 100 microamperes per part per million of nitrogen tetroxide, 52 microamperes per part per million of ozone, 40 microamperes per part per million of hydrazine, and 20 microamperes per part per million of unsymmetrical dimethylhydrazine. (Author's abstract)

07710

Wilson, W.L.,M.W. Campbell,L.D. Eddy, and W.H. Poppe

CALIBRATION OF LIMED FILTER PAPER FOR MEASURING SHORT-TERM HYDRO- GEN FLUORIDE DOSAGES. THE EFFECT OF TEMPERATURE, HUMIDITY, WIND SPEED, AND DOSE. Am. Ind. Hyg. Assoc. J., 28(3):254-249, May-June 1967. 5 refs.

Limed filter papers were exposed to analyzed concentrations of hydrogen fluoride under controlled conditions of temperature, dew point, concentration, windspeed and time. The exposed papers were analyzed for their fluoride content. Wintin the limits of accuracy of the test setup, the following conclusions are made: Temperature, dew point, concentration, and time have little or no effect on absorption. Dose has little or no effect on absorption until dosages in excess of 400 to 600 ppm min, dependent on windspeed, are reached. Within the limits of 3 to 18 mph, absorption varies with dosage according to a given equation. (Authors' abstract)

07719

Keplinger, M. L.

REPORT OF TOXIC EFFECTS OF FLUORINE FOLLOWING SHORT- TERMINHALATION. Miami Univ. School of Medicine, Coral Gables, Fla., Dept. of Pharmacology, Contract NGR10-007-012, Rept. CR- 76741, 73p., May 31, 1966. NASA: N66-32296

In order to broaden the knowledge of the hazards of short-term exposures to fluorine from rocket propellants, experimental animals were exposed to fluorine for short periods of time. The concentrations in the exposure chamber were extremely important. Since suitable analytical methods were not available, they were developed. Special equipment, including a chamber for exposures, was designed and built to handle fluorine safely. Colorimetric methods were used for the measurement of the concentrations of fluorine and fluorides in the air of the exposure chamber. Analytical methods for fluorine in air, using gas-liquid chromatography, were pursued. A thermal conductivity detector measured the fluorine, but was not sensitivw enough for these purposes. Indirect measurement of fluorine, by conversion to chlorine, with a thermionic flame detector appeared to be satisfactory. Signs of intoxication

from high concentrations of fluorine in air were marked irritation of the mucous membranes of the eyes and respiratory tract. The skin of the animals showed some irritation at the concentrations used. The LC50 (concentration calculated to kill 50% of the animals) was determined for 5, 15, 30, and 60 minutes of exposure in both rats and mice, for 15 and 60 minutes in guinea pigs, and for 5 and 30 minutes in rabbits. There were no significant differences between the LC50's for the different species. Following sublethal exposures, effects in the lung were observed immediately. Effects in the kidney (and in the liver) were observed first on the seventh to fourteenth day following exposure. Pathology in the lung or kidney occurred from exposure to almost the same concentration. Exposure to higher concentrations was necessary before pathology was observed in the liver. Concentrations at or below 100 ppm for 5 minutes, 70 ppm for 15 minutes, 55 ppm for 30 minutes, or 45 ppm for 60 minutes caused no apparent effects in the animals.

07763

Thompson, C. Ray, L. F. Zielenski, and J. O. Ivie

A SIMPLIFIED FLUOROMETRIC FLUORIDE ANALYZER. Atmos. Environ., 1(3):253-259, May 1967. 12 refs.

A fluorometric fluoride analyzer previously described has been redesigned and simplified to provide a more usable instrument. A single photomultiplier tube is used to receive alternate light pulses rather than the two tubes used formerly. Illumination of the sensitized tape is accomplished by two ultraviolet lamps. The electronic circuitry for tape illumination and carrying of signals to the recorder has been simplified. A light 0piping0 system improves light transmission and the bulk and weight of the overall equipment has been reduced to about one-half. (Authors' abstract)

07860

V. L. Eggebraaten, L. E. Miller

DETECTION OF FREE FLUORINE IN THE ATMOSPHERE BY I131 RADIOTRACER ANALYSIS. Intern. J. Appl. Radiation Isotopes, Vol. 18, p.183-191, March 1967. 6 refs.

The chemical displacement reaction, in which combined fluorine combines with free iodine to yield combined iodine and free fluorine, has been evaluated as a means of detecting and measuring free fluorine in the atmosphere. The objectives of this program have been to determine the chemical properties of this reaction at micro-concentration levels, to develop the calibration techniques which will produce a working analytical procedure, and to predict the potential service of this system as a compact, portable type instrument for performing atmospheric determinations on field locations. The basic experimentation involves passing atmospheric gases through alkali iodide columns tagged with radioactive I131, which is released and captured in a sodium thiosulfate solution upon exposure to calibrated quantities fo fluorine contamination. Determining quantitative amounts of fluorine in ppb quantities, instantaneous recording of the atmospheric contamination, discriminating between elemental and combined fluorine, and instrument portability are the favorable features sought with this radio release technique. (Authors' abstract)

07871

Farrah, George H.

MANUAL PROCEDURES FOR THE ESTIMATION OF ATMOSPHERIC FLUORIDES.J. Air Pollution Control Assoc., 17(11):738-741, Nov. 1967. 18 refs.

Manual methods for the determination of air-borne fluorides, including the discrimination of gaseous and particulate forms, are reviewed. Published methods are re-examined and comparative sampling data presented, to point out advantages of some newer techniques in sampling, separation, and quantitation. There are several alternatives to the classical methods of sampling and determination of air-borne fluorides. The bulky, fragile, liquid- filled scrubbers can be replaced with simple, rugged, dry collectors. When separation of interfering ions is necessary, ion exchange can generally affect it for a fraction of the cost in time and equipment required for Willard-Winter distillation. And finally, the wide range of sensitivities afforded by instrumental methods, either spectrophotometric or electrometric, can eliminate the need for developing a career man to titrate fluoride. Unfortunately, there seems to be no alternative to vigilance in reducing the errors in measuring air sample volumes and avoiding contamination from equipment and reagents.

08077

Johnson, F. A.

DETECTION OF LOW LEVELS OF TETRAFLUOROHYDRAZINE IN AIR.Rohm and Haas Co., Huntsville, Ala., Redstone Research Labs., Contract DAAHOI-67-C-0655, S-137, 19p., June 1967. DDC: AD 815940

Tetrafluorohydrazine was converted to fluoride ion by nitrogen dioxide and water. The fluoride ion was detected continuously by a commercial fluoride ion electrode. A 30-mV change in electrode potential was obtained for one part per million of N2F4 in the air. Various factors affecting sensitivity, stability, and speed of the detection system were considered. (Author0s abstract)

09560

Bond, A. M., and T. A. O'Donnell

DETERMINATION OF FLUORIDE BY ATOMIC ABSORPTION SPECTROMETRY. Anal. Chem., 40(3):560-563, March 1968. 14 refs.

Fluoride ion depresses the absorption of magnesium in the air-coal gas flame, the change in absorbance of the magnesium resonance line at 2852 A being proportional to the fluoride concentration over the range 0.2-20 microgram/ml. In the absence of interfering ions, principally sulfate and phosphate, the effect can be used to determine fluoride ion in this concentration range. An alternative, though somewhat less sensitive, technique is based on the enhancement of zirconium absorption by fluoride ion in the nitrous oxideacetylene flame; this allows the determination, with a high degree of freedom from interference, of fluoride ion over the range 3-200 microgram/ml. In the presence of phosphate, which interferes with the zirconium method, a similar enhancement of titanium absorption can be used for fluoride determinations in the range 40 400 microgram/ml. These atomic absorption methods for fluoride determinations have been found to be considerably more rapid than more classical methods and in many cases can be used directly without prior separation of fluoride. Their application has been demonstrated in the analysis of a wide range of inorganic fluorides. (Author 's abstract, modified)

09770

Townsend, C. R., G. A. Giarrusso, and H. P. Silverman

THIN FILM PERSONAL DOSIMETERS FOR DETECTING TOXIC PROPELLANTS. Magna Corp., Redondo Beach, Calif., Research and Develop- ment Div., Contract AF-33(615)-1751, Proj. 6302, Task 630203, AMRL-TR-66-231, 59p., Feb.

1967. 1 ref. 1967. 1 ref. CFSTI, DDC: AD 652849 CFSTI, DDC: AD 652849

The subject of this report is the development of a portable system for the detection of low concentrations of nitrogen tetroxide (N2O4), fluorine (F2), and unsymmetrical dimethylhydrazine (UDMH) in air. The detection system is based upon the change of electrical resistivity of thin metal films when exposed to these gases. Silver metal films coated with appropriate salts proved to be applicable to the detection of all three gases; however, the following sensitized metal films were found to be optimum: for N2O4, silver; for F2, copper; and for UDMH, gold. Using the best film and salt combinations found to date, N2O4 could be monitored over the range of 0.1 to 50 ppm, F2 over the range 1.0 to 50 ppm, and UDMH over the range 10 to 100 ppm, with a standard deviation of about 20 percent. The effects of temperature over the range 50 deg. to 90 deg. C and of humidity from 10 to 90 percent on the response characteristics of the thin film sensors were found to be significant but within the tolerance limits. Means for reducing these effects were suggested which, if successful, would, in effect, make this detection system practically independent of changes in the environment. A portable breadboard readout instrument was designed and fabricated for use with the sensors to form an integrated detection system for personal protection. (Authors' abstract)

09983

Ubl, Z.

UNIFIED METHODS FOR THE ANALYSIS OF POLLUTANTS IN THE FREE ATMOS- PHERE. Acta Hygienica, No. 1, Suppl, 1966. 84p. 24 refs.

Methods for the analysis of pollutants in the air are presented with precise and complete notes dealing with procedure, apparatus, reagents, and possible problems. Procedures are given for determining the following compounds in the air: SO2, CO, NO2, NOx, sulfuric acid aerosols, Cl2, H2S, Pb compounds, CS2, phenol, As, F2, NH3, soot, Mn compounds, SiO2, and formaldehyde. Also discussed are methods of air sampling, calibration methods, calculations, sensitivity and error in the determinations interferences from other compounds, and the principle involved in the method.

10632

Finkel'shtein, D. N., N. A. Polykovskaya, and N. M. Morozova

SEPARATE DETERMINATION OF FLUORINE AND ALUMINUM COMPOUNDS IN AIR IN AND AROUND FACTORIES. ((Razdel'noe opredelenie ftoristykh i alyuminievykh soedinenii v vozdukhe proizvodstvennykh pomeshchenii i okruzhayuschikh territorii.)) Hyg. & Sanit. (English translation of: Gigiena i Sanit.), 33(1-3):212-216, Jan.-March 1968. 5 refs. CFSTI: TT 68-50449/1

A method for the separate determination of hydrogen fluoride (gaseous and mist) fluorides (NaF, AlF3, NaAlF6) and aluminum oxide when they are simultaneously in the air was studied. Two methods, one desorptional and one chemical, were elaborated for separate determinations of HF, fluorides nd Al2O3 from a single air sample. Conditions were determined for combined sampling of air with minimum adsorption of HF on the filter. The solubility of aluminum fluorides in water was demonstrated to be drastically reduced by roasting, so that the aerogel must be extracted from the filters with 0.2 N alkali solution.

10966

L. A. Elfers, C.E. Decker

DETERMINATION OF FLUORIDE IN AIR AND STACK GAS SAMPLES BY USE OF AN ION SPECIFIC ELECTRODE. Anal. Chem., 40(11):1658-1661, Sept. 1968.

An analytical procedure for the determination of water-soluble fluoride in air and stack gas samples using a specific-ion electrode is described. Gaseous and particulate fluoride in ambient air are collected by filtration and chemisorption on membrane filters impregnated with sodium formate. Data pertaining to the collection efficiency and the dissolution of collected fluorides from ambient air samples are presented. As little as 0.25 part per billion fluoride in air can be measured with this procedure. Gaseous fluorides in stack gas are collected by reaction with a hot glass probe to form gaseous silicon tetrafluoride, which hydrolyzes in water to form soluble fluosilicic acid. Results obtained with the electrode and the Spadns-Zirconium Lake Method for fluoride in stack gas were compared, and at the 0.05 significance level, no difference existed in the two methods. This relatively new analytical tool, as applied to the analysis of air pollutants, has been shown to be rapid and convenient, and appears to be less susceptible to interferences than other methods presently available for the measurement of fluoride. (Authors' abstract)

11041

Jacobson, J. S., L. H. Weinstein, and R. Mandl

A NEW CONTINUOUS AIR MONITOR FOR FLUORIDES. Preprint, Royce Thompson Inst. for Plant Research, Inc., Yonkers, N. Y., ((15)) p., 1968. 9 refs. (Presented at the 61st Annual Meeting of the Air Pollution Control Association, St. Paul, Minn., June 23-27, 1968, Paper 68-86.)

An efficient scrubber for removing water-soluble fluorides from air on a continuous basis has been developed. More than 95 per cent of hydrogen fluoride in the microgram to milligram per cubic meter range is transferred to aqueous solution at air flow rates up to 25 liter per minute. An Orion fluoride combination electrode was used to obtain continuous measurement of the fluoride content of aqueous solution present in the scrubber. Response to atmosphere containing as little as 0.5 micrograms fluoride per cubic meter can be obtained. Use of an Orion meter and proper adjustment of air and liquid flow rates can provide a direct readout in micrograms fluoride per cubic meter over a 100-fold range in concentration. Evaporation of solution during scrubbing is, however, a major source of error. Efforts are currently being made to overcome this difficulty. (Authors' abstract)

11404

K. Habel

THE SEPARATION OF GASEOUS AND SOLID FLUORINE COMPOUNDS DURING AIR-QUALITY MEASUREMENTS. Staub (English translation), 28(7):26-31, July 1968. 4 refs. CFSTI: TT 68-50448/7

A method for the separation of gaseous and solid fluorine compounds is described in the case of immission measurements. Solid fluorine compounds are separated from gaseous compounds with the help of a quartz filter head by using diaphragm filters. This filter is installed before the absorption arrangement for gaseous fluorine compounds. Dust deposited on the filter is prepared, together with the filter, for fluoride determination. By weighing the filter it is also possible to carry out a dust content determination. The separation method permits the amounts of gaseous and solid fluorine compounds to be expressed with sufficient accuracy in the case of immission measurements. (Author's summary, modified)

11574

Lahmann, Erdwin

STUDIES ON AIR POLLUTANTS. I. ANALYTICAL METHODS. ((Die Untersuchung von Luftverunreinigungen. I. Analysenmethoden.)) Text in German. Bundesgesundheitsblatt, (10):145-150, May 12, 1967. 71 refs.

This detailed review of the apparatus and techniques used for air pollution measurements deals with both sampling and analytical methods. A distinction is made between empirical or discontinuous and continuous methods of sampling and it is pointed out that only the latter can yield readily interpretable results. In connection with gas sampling techniques, the value of an impinger for increasing the rate of dissolution of gaseous pollutants is discussed. Methods are then described for the quantitative determination of SO2, SO3, NO2, NO, CO, H2S, HF, and NH3, and brief mention is made of the techniques of gas chromatography and flame ionization detection for traces of organic compounds. The two principal techniques for estimating the total particulate content of the air are dust-fall and dust-concentration determinations. The latter which depends on photoelectric measurement of the particle density after filtration is more difficult to perform, but more interesting from the health point of view.

11626

Brune, D., S. Mattsson, and K. Liden

APPLICATION OF A BETATRON IN PHOTONUCLEAR ACTIVATION ANALYSIS. Aktiebolaget Atomenergi (Stockholm), AE-333, 1968. 19 refs.

Determinations of iodine in pharmaceuticals and of fluorine, lead, and mercury in pure compounds were made by photonuclear activation analysis, with a betatron accelerator used as the irradiation facility. The accelerator yields a lower photon flux density than a linear accelerator but has great flexibility with regard to beam direction. Uniform irradiation of the samples was achieved by inserting a rotating sample holder device in the brehmstrahlung beam of the betatron. The detection limits obtained for iodine, fluorine, lead, and mercury were 50, 3, 400, and 15 micrograms, respectively. It is concluded that the betatron has practical applications in the field of pharmacy but is unsuited for lead analyses in pollution studies of air, water, and food. It could be used for the determination of mercury in various biological materials, though better results are expected to be obtained by conventional neutron activation techniques.

11678

Kennedy, E. D. and E. E. Pennell

INDUSTRIAL APPLICATIONS OF THE SEMI-AUTOMATED FLUORINE ANALYZER. Am. Chem. Soc., Div. Water, Air, Waste Chem. Preprints, 7(1):235-236, 1967.

A semi-automated method of fluoride analysis is based on flashing an acidified sample to a fractionating column, sweeping the distilled fluoride and water to a microcondensor, and mixing the condensate with alizarin fluorine blue-lanthanum reagent. The mixture is then passed to a colorimeter which measures absorbance at 624 millimicrons. The impluse received is recorded on a chart indicating optical density. Samples of air and liquid plant effluents are analyzed directly or after proper dilution to the concentration range of 0.40-4.0 micrograms F/ml. Good results are also obtained when the method is used to monitor phosphate products requiring strict control of fluoride levels.

11691

Jacobson, Jay S.

PERMEATION TUBES AS GASEOUS HYDROGEN FLUORIDE SOURCES. Am. Chem. Soc., Div. Water, Air, Waste Chem., 7(1):232-234, 1967.

The permeation tube technique offers a simple means of obtaining standards for trace gas analyses, since the tubes are calibrated gravimetrically. The constructions of permeation tubes for delivering known amounts of gaseous fluoride at a constant rate is described. Sources of gaseous fluoride, the resistance of tubing to chemical attack by fluorides, and various techniques of sealing tubes are evaluated. Developmental work indicated that permeation tubes can be constructed containing pure, liquid hydrogen fluoride in polyethylene or polypropylene tubing under specified sealing techniques; at present, however no foolproof sealing method is known. The best combination of materials and techniques was used to calibrate tubes gravimetrically under controlled temperatures to determine whether losses in weight were occurring and whether weight losses were relatively constant with time. Repeated weighing of different tubes gave weight losses of 80 to 210 micrograms/hr per tube or 10-14 micrograms/hr per sq cm of diffusing surface for polypropylene tubes and 3-5 micrograms/hr per sq cm of diffusing surface for polypropylene tubes. A third phase of the work still in progress, involves determining whether the reductions in weight are a direct and exact measure of permeation of gaseous fluoride. The future value of permeation tubes as standards for atmospheric fluoride measurements appears to depend on the reduction of variability and on establishing the constancy of permeation over long time intervals.

11779

J. O. Ivie, E. R. Hendrickson

PERFORMANCE OF FLUORESCENT TYPE FLUORIDE RECORDERS FOR AMBIENT USE. Preprint, Instrument Development Co., Reston, Va. and Resources Research,Inc., Gainesville, Fla.,((20))p., ((1967)) 8 refs (Presented at the 153rd meeting of the American Chemical Society, Miami Beach, Fla., April 10-14, 1967.)

A brief review is given of the original fluorescent tape fluoride sample for ambient air as developed by Thomas, 1958, and of changes that were made to improve the instrument. Double and single photomultiplier tube units are illustrated. Performances in field tests are given, and the need and use of simultaneous impinger samples for correcting peak values given by the samplers are explained. (Author's abstract)

11915

W. Schneider, and E. Schoeffmann

COMPARATIVE STUDIES OF FLUORINE-CONTAINING EMISSIONS. ((Vergleichende Untersuchungen uber Fluorhaltige Immissionen.)) Text in German. Stadtehygiene, 19(6):114-115, June 1968.

Three methods determining the presence of fluorine compounds as phytotoxic air pollutants are under consideration: (1) air analysis, (2) precipitate analysis, and (3) plant studies. In the past, proof of damage was accepted if fluorine concentrations in the leaves of damaged plants were higher than those in plants in unpolluted areas. Recently air measurements were made at 7 stations in a recreation area containing large forests and several water surfaces, at the same time as dust studies of precipitates from washed and unwashed birch, popular, and plantain leaves. The differences found in the fluorine values (0.5-1.0 microgram F/N cu m in the air and 25.8

mg F/sq.m. in the percipitate) may be partially attributed to the filtration effect of forests (particularly with aerosols) which results in reduced emissions (the authors' belief). An increased concentration of fluorine in plants is neither proof of increased fluorine in the air nor the cause of plant damage. Leaves from plants both with and without damage showed an increased fluorine content with little difference between values. The most common fluorine compound, calcium fluoride, does not cause plant damage and occurs only as a dust which is trapped by dense forests. Because of this, the point of collection is important when measuring for fluorides. Fluoride emissions in industrial concentrations are difficult to determine because of small fluoride emissions coming from many directions.

12100

Anon.

FLUORIDE DETECTOR DEVELOPED IN CANADA. Can. Chem. Process., 52(16):86-88, Oct. 1968.

Trace amounts of fluorides in the atmosphere can be detected by means of an automatic analyzer developed by the Ontario Research Foundation and now being built commercially by Leigh Instruments of Ottawa. The analyzer uses a Na2CO3-coated absorber tube to collect the gaseous fluorides. These are then flushed from the tube with a modified Megregian solution (a zirconium-eriochrome cyanine complex), and the amount of the fluoride ion is determined photometrically. The analyzer operates unattended continuously, except for weekly recharging of reagents, and can detect gaseous fluorides in ambient air when concentrations are as low as 0.1 microgram of fluoride ion per cu m or approximately 1 part per billion.

12334

Morgan, George B., Jack C. Fensterstock, and Thomas B. McMullen

THE DETERMINATION OF ATMOSPHERIC FLUORIDES USING THE FLUORIDE ION ELECTRODE. Preprint, American Society for Testing and Materials, Philadelphia, Pa., 23p., 1968. 6 refs. (Presented at the Conference on Air Quality, Plainfield, Vt., 1968.)

The application of a fluoride-selective electrode as a new analytical tool for measuring the concentration of fluorides in ambient air is described. This electrode consists of a laser-type, single-crystal membrane of europium-doped lathanum fluoride, which is highly specific for the fluoride ion. When used in conjunction with a calomel reference electrode, it gives a Nernstian response over a concentration range of more than four orders of magnitude. The electrode is very useful in easily and rapidly measuring atmospheric fluorides collected on glass fiber filters. This is of extreme importance, as this instrument can then be applied to the samples routinely collected by the National Air Surveillance Networks (NASN) or similar surveillance agencies. Virtually all of the fluoride that is collected on both glass fiber filters and membrane filters is water soluble, indicating that this method can replace the slow and tedious colorimetric procedures. Another important factor is that all the fluoride collected on glass fiber filters is biologically active. The electrode is stable and quite reproducible. Sensitivity of the electrode is comparable to that of SPDNS method. The fluoride ion activity measured in aqueous extracts of atmospheric particulates was directly related to the total fluoride concentration in the atmosphere. Using the electrode technique, the fluoride concentration at NASN sites (both urban and nonurban) during the 1966 sampling year were surveyed. Data are presented for samples collected at 150 stations over a 12-month period. A cursory examination of the data shows a possible relationship between certain sources and observed fluoride levels. (Author abstract modified)

12451

Takeuchi, Juji, Eiichi Ito, Kiyoshi Kubo, Masako Kusumoto, Toshio Toyama, Takeo Arakawa, Itsuro Chida, Samon Maeda, Masami Arai, Koichi Murakami, Gunji Kawasaki, Toshiro Matsumura, Yukio Kubo, Yuki Morishita, Kunihiko Asagino, Kikuji Kimura, Noboru Yamate, Mitsuru Udagawa, Kazuo Shimizu, Kentaro Yagome, Masanobu Nagata, Kimiko Fujie, and Toshiichi Okita

MEASURING METHODS. (2). Taiki Osen Kenkyu (J. Japan. Soc. Air Pollution), 2(1):80-87, 1967. Translated from Japanese. 32p.

Experimental procedures employed in atmospheric contaminant studies are briefly reviewed and evaluated. They concern the following: measurement of atmospheric acrolein; measurement of aerosol weight distribution with a cascade centripeter; determination of NO3-N in water collected in deposit gauges; continuous colorimetric measurement of atmospheric formaldehyde; measurement of SF6 employed as a tracer of exhaust gas; simple determination of trace quantities of atmospheric fluoride with alkalized filter paper; and determinations of the correlation between concentrations of aerosols and radon. Also reported are measurements of air particle pollutants with a self-recording impactor; a survey of air pollution based on automatic recorders; the use of a telemeter system to transmit data from the automatic recorders; the development of a stablized high voltage power source for the measurement of size distribution and concentration of particles in the atmosphere and in flue gas; measurements of atmospheric trace metals by emission spectrophotometry and atomic absorption spectrophotometry; measurements of particles with high volume samplers; studies of the efficiencies of shelters used in the Pb02 candle method for sulfation rate measurements; and a procedure for measuring aldehyde concentrations in the atmosphere.

12593

Wallar, Margaret A. and Normal A. Huey

EVALUATION OF A STATIC MONITOR OF THE ATMOSPHERIC ACTIVITY OF SULFUR OXIDES, NITROGEN DIOXIDE, AND CHLORIDE. Preprint, Air Pollution Control Assoc., Pittsburgh, Pa., 13p., 1969. 3 refs. (Presented at the Air Pollution Control Association, Annual Meeting, 62nd, New York, June 22-26, 1969, Paper 69-96.)

A static, multipurpose monitor for acidic gases was developed and tested under field conditions. The collection device is a 4.8 centimeter inside diameter plastic petri dish containing a filter impregnated with 1 ml 30% potassium carbonate solution. The dish is placed in the open air in an inverted position. After exposure, the filter is removed for analysis and placed in a 50-milliliter test tube, covered with distilled water and heated in a boiling water bath for 15 min. The sample is then diluted to a known volume and filtered. The filtrate is analyzed for oxides of sulfur, oxides of nitrogen, chloride and/or fluoride by the barium sulfate turbidimetric method, the diazoting method, the mercuric thiocyanate method, and the use of a specific ion electrode respectively. The carbonate plate was exposed in parallel with the lead plate in the Cincinnati metropolitan area, at selected sites in the Port Huron, Michigan-Sarnia, Ontario Saturation Study, in the Philadelphia-Trenton area, and on the Interstate Surveillance Network. The oxides of sulfur results compare favorably with existing sulfation data. The carbonate plate seems to be a satisfactory indicator of the activity of oxides of nitrogen, chloride, and fluoride in the atmosphere. (Author abstract modified)

12760

Levaggi, D. A., W. Oyung, and M. Feldstein

A COMPARATIVE STUDY OF THE DETERMINATION OF FLUORIDE ON LIME PAPER BY A COLORIMETRIC METHOD AND THE SPECIFIC ION ELECTRODE METHOD. Preprint, California State Dept. of Public Health, Berkeley and California Air Resources Board, 8p., 1969. 13 refs. (Presented at the Conference on Methods in Air Pollution and Industrial Hygiene Studies, 10th, San Francisco, Calif., Feb. 19-21, 1969.)

Comparison of a colorimetric and a specific ion electrode method for the determination of fluoride on lime paper indicates that the static lime paper technique is greatly simplified by the use of the specific fluoride electrode. Lime papers can now be analyzed quickly and easily by simple extraction and direct meter reading. One hundred samples can be analyzed easily in an 8-hour day with great accuracy and specificity. The extreme sensitivity of the Orion Meter allows for ambient air area studies as well as source effluent tracer studies. Standardization of the Orion Meter is described. (Author summary modified)

13056

Bourbon, P. and J. Alary

DETERMINATION OF FLUORIDE POLLUTION BY A RAPID TECHNIQUE UTILIZING PAPER IMPREGNATED WITH SODA. (Evaluation de la pollution fluoree par une technique rapide utilisant des papiers impregnes de soude). Text in French. Bull. INSERM, 24(1):23-30, Jan.-Feb. 1969.

Previously, Whatman paper impregnated with lime had been used to determine fluoride poliution in an aluminum factory. The same technique using paper impregnated with a 1 N solution of soda gave better recovery of fluoride than lime paper in tests made in six locations over a period of six months. After exposure, the papers were lacertated and extracted with water. Fluoride was determined colorimetrically either directly on an aliquot of the washings, or after distillation to minimize interfering impurities. Although the distillation method gave slightly better results, the direct method was simpler and more applicable to industrial usage.

14288

Guerrant, Gordon O.

METHOD AND APPARATUS FOR CONTINUOUS MONITORING OF FLUORIDE EFFLUENT. (USS Agri-Chemicals, Inc., Pittsburgh) U. S. Pat. 3,461,043. 3p., Aug. 12, 1969. 5 refs. (Appl. May 3, 1965, 7 claims).

The invention relates to a process and apparatus for the continuous monitoring of fluoride effluent by internal electrolysis. It is particularly suited to the remote monitoring of fluoride evolution in phosphate fertilizer manufacturing processes or to the determination, either in the field or on plant premises, of fluorides in waste gases. Monitoring is accomplished by contacting fluoride-containing gas with a dilute acid electrolyte, which forms a film on the tubing walls on which the fluoride is absorbed, and then passing the electrolyte from which gas has been removed through an electrolysis cell provided with electrodes for spontaneously generating current flow, withdrawing the electrolyte, and measuring the current flow. Since the electrolyte flows by gravity into the tubing, minimum electrolyte volume is required for absorption of gaseous fluorides to provide maximum response.

15171

Yamate, Noburu

MANUAL METHODS AND AUTOMATIC CONTINUOUS INSTRUMENTS FOR MEASUREMENT OF GASEOUS AIR POLLUTANTS. (Gasujo taiki osenbitsu no sokutei to sono sokuteikiki). Text in Japanese. Kogai to Taisaku (J. Pollution Control), 5(10):785-796, Oct. 1969. 36 refs.

In order to prevent air pollution, measurement of pollutant concentrations must be continuously performed. In this report, both continuous monitoring and manual analyses of typical air pollutants are reviewed. Numerous methods are tabulated and most of them are explained, with particular attention to continuous methods and apparatus. Sulfides are measured manually by colorimetric analysis with rosaniline or barium molybdate, by the lead per oxide method, or by test paper methods. Sulfides are also measured continuously by means of solution conductance (Thomas autometer) or by optical absorption with rosaniline or with iodine-starch. Carbon monoxide is measured manually with palladium sulfate and ammonium molybdate, by gas chromatography, or by the hopcalite method. It is measured continuously by infrared or ultraviolet absorption of reduced mercuric oxide. Nitrides are measured manually by the Saltzman or the Jacobs method, or with ortho-tolidine sulfate. Hydrogen sulfide is measured manually by methylene blue and continuously by a colorimetric filter paper method. Hydrocarbons are measured manually by gas chromatography and continuously by flame ionization detectors. Formaldehyde is measured manually by colorimetric analysis with a chromotropic acid or with acetylacetone, or by the MBTH method. Ozone is measured manually by the phenolphthalein or the potassium iodide method and continuously by coulometric titration or by optical absorption with potassium iodide. Fluorides are measured manually by colorimetric analysis with thorium neothron(?) or lanthanum alizarin complex and continuously by filter paper fluorescence. Actual Tokyo data on changes in the concentrations of carbon monoxide, nitric oxide, and nitrogen dioxide are tabulated.

15355

Luis, P., C. N. Carducci, and A. Sa

DETECTION OF FLUORINE ON THE NANOGRAM SCALE; INORGANIC AND ORGANIC FLUORINE COMPOUNDS. Mikrochim. Acta (Vienna), no. 4:870-881, 1969. 6 refs.

Simple techniques are described for detecting fluorine on the nanogram scale. They are based on the evolution of hydrofluoric acid as revealed by an alizarin-3-methylamine-N,N'-diacetic acid-cerium(III) complex reagent and the use of a Pyrex capillary siliconized to prevent the glass from retaining hydrofluoric acid at ordinary temperatures. The methods are suitable for the detection of fluoride in waters, minerals, salts, and organic compounds including complex pharmaceutical preparations and plastics. Even 150 pg of fluorine can be revealed in a 1:500,000 solution of the reagent.

16109

Vertes, Michael A. and Harry G. Oswin

METHOD AND APPARATUS FOR DETECTING GAS. (Leesona Corp., Warwick, R. I.) U. S. Pat. 3,470,071. 5p., Sept. 30, 1969. 5 refs. (Appl. July 11, 1966, 15 claims).

The increasing industrial use of hydrogen cyanide derivatives, which emit only a faint odor, and the increasing military use of organophosphorous compounds require a rapid and portable gas detection system. Previously suggested electrolysis systems need a great deal of ancillary equipment for circulating the electrolyte and for scrubbing and circulating air. They

are not conveniently manufactured. A detector for sensing these and other noxious gases is described that operates by spontaneous electrolysis and has a spontaneous alarm unit and a high electrode-electrolyte-gas contact area. It is easily manufactured in compact form. The detector comprises an anode, a cathode, an electrolyte, and an external circuit in which the warning signal connects the anode and cathode. The anode and cathode contain liquid impermeable and gas permeable polymer membranes coated at one surface with a catalytic layer. The catalytic layer of the cathode is electrochemically active with respect to the oxygen of its environment and invariant to the gas being detected, while the catalytic layer of the anode includes a material reactive to the gas to be detected. Each catalytic layer is in contact with the electrolyte and each membrane, with the atmosphere. The electrolyte is an oxine; the polymer membranes, polytetrafluoroethylene; the catalytic layer of the anode, a mixture of hydrophobic polymer particles, silver or gold; and the catalytic layer of the cathode, a mixture of hydrophobic polymer particles and platinum black. The system is also capable for detecting hydrogen sulfide and hydrogen fluoride gases.

16801

Marshall, B. S. and R. Wood

THE DETERMINATION OF TOTAL FLUORIDE IN AIR BY USING A MICRODIFFUSION TECHNIQUE. Analyst, 94(1119):493-499, June 1969. 14 refs.

A method is described for the determination of total fluoride, in the form of dust, fume or vapor, in industrial atmospheres; it is applicable over a wide range of fluoride concentrations. After collection on an alkali-impregnated filter-paper, the fluoride is released specifically in a micro-diffusion vessel and trapped by an alkaline coating on the inside of the lid of the vessel. The alkali is quantitatively transferred to a standard flask and the fluoride determined spectrophotometrically or visually with the lanthanum - alizarin fluorine blue reagent. The apparatus used is simple and the manipulation time required is less than 30 min per sample, although the microdiffusion stage requires a minimum of 16 hr (overnight) for completion. (Author's Abstract)

16969

Brandt, C. Stafford

FLUORIDE ANALYSIS. Intern. J. Air Water Pollution (London), vol. 7:1061-1065, 1963. 49 refs.

Methods and procedures for the detection and estimation of fluoride are reviewed. Difficulties associated with separating the particulate fluoride from gaseous fluoride are considered. The most satisfactory method developed to date is to collect the fluoride in a bubbler, fix it with alkali, and analyze the sample by water techniques. The need to fix fluoride samples with lime during drying and ashing has been established for plant materials but not for animal tissues. For analyzing plant and animal tissues and aqueous acidified solutions from air samples, isolation based on ion exchange resins has found increasing applications. For estimation of low levels of fluoride, after isolation from the sample, various colorimetric and spectrophotometric methods are replacing titration procedures. There is still no adequate automatic air monitoring instrument for fluorides, though field tests of a recorder based on the quenching of fluorescence on an impregnated tape appear promising. The detection limit is expected to be less than 0.1 micron F/cu m. Recently developed automatic systems for high level concentrations are subject to a wide variety of interferences.

17082

Buck, M. and H. Stratmann

A METHOD TO DETERMINE VERY SMALL CONCENTRATIONS OF FLUORINE IONS IN THE ATMOSPHERE. (Ein Verfahren zur Bestimmung sehr geringer Konzentrationen von Fluor-Ionen in der Atmosphaere). Brennstoff- Chem. (Essen), 46(8):231-235, Aug. 1965. 13 refs. Translated from German. Franklin Inst. Research Labs., Philadelphia, Pa., Science Info. Services, 19p., Sept. 18, 1969.

A method was described by which fluorine ions are collected and absorbed in prepared silver tubes to determine very small F(-) concentrations in the air. After separation of the fluorine ions from interfering substances by water vapor distillation, the F(-) concentration is determined photometrically by the alizarine complex method. The distilled amounts of F(-) are absorbed in a small amount of diluted sodium lye. No water vapor condensation occurs at this process. The relative detection threshold of this method under standard conditions is 0.7 micrograms F(-)/cu m. The standard deviations were found to be + or - 0.4 micrograms F(-)/cu m in a concentration range from 2-10 micrograms F(-)/cu m. The sampling equipment can be easily installed in a truck so that the method is particularly suited for emission measurements which require sampling at different locations. As compared to the impinger method, this method has the advantage of having greater sensitivity and accuracy and is simple to handle. (Author summary modified)

17092

Nichols, P. N. R.

THE SIMPLE MODIFICATION OF A COMMERCIAL SULPHUR DIOXIDE METER FOR THE DETERMINATION OF OTHER ATMOSPHERIC POLLUTANTS. Chem. Ind. (London), 1654-1655, Sept. 26, 1964. 12 refs.

A modified commercial sulphur dioxide meter used for routine determination of contaminants in the atmosphere is described and illustrated. The design of the instrument suggests that, by a suitable choice of reagent and optical filter, it could be readily adapted for the measurement of other atmospheric pollutants. Among the pollutants of interest were hydrogen sulfide, nitrous fumes, fluoride, chloride, free chlorine, and organic chloro-compounds. Conditions under which all these pollutants were successfully determined, with an estimate of the sensitivity attained, are given in a table. Air suspected of contamination with sulfur dioxide is passed up a counter-current absorption column down which is flowing a starch-iodine reagent. The reagent is partially decolorized by the sulfur dioxide; the change in color is measured photometrically and related directly to the concentration of sulfur dioxide. The out-of-balance current produced from the two photocells is measured on a galvanometer.

17098

Radczewski, O. E.

FINE POWDERS (DUSTS) IN NATURE AND IN INDUSTRY, THEIR DETERMINATION AS CONTAMINANTS AND DETERMINATION OF FLUORINE COMPOUNDS IN THE AIR. (Feine Teilchen (Staeube) in Natur und Technik, ihre Bestimmung als Verunreinigungen und der Nachweis von Fluorverbindungen in der Luft). Text in German. Ber. Deut. Keram. Ges., 45(11):551-556, Nov. 1968. 9 refs.

The morphological significance of particles for their properties and the demonstration of industrial powders in the form of photographs and samples was presented. Electron diffraction is an important method because it allows a clear identification of extremely fine particles. Kaolinite and illite can be distinguished from each other or amorphous silica can be detected

in Knerlich clay. Contaminants in the air surrounding an aluminum factory were collected and electron-optically studied. Crystalline impurities in the atmosphere and the type and bonding of fluorine compounds in the exhausts of furnaces and kilns was also investigated with an electron-optical device. An unequivocal determination was made possible by examining cell sizes in the selected area of diffraction and by measuring the angles between the different lattice directions. The results showed that chlorides, sulfates, and fluorine compounds were present in the air above the North Sea and in the exhaust gases of an aluminum smelting furnace. (Author summary modified)

17117

Bewers, J. M. and F. C. Flack

DETERMINATION OF FLUORINE BY PROMPT (GAMMA)-RADIATION FROM PROTON BOMBARDMENT. PART I. THEORY AND EXPERIMENTAL METHOD. Analyst (Cambridge), 94(1114):1-6, Jan. 1969. 19 refs. PART II. RESULTS. 94(1114):7-14, Jan. 1969. 5 refs.

The general principles governing the quantitative measurement of fluorine by proton bombardment are described. An expression for the limit of detection is derived; the importance of the stopping cross-section is discussed, and experimental arrangements are described. Part II presents the experimental results. The practical application of the nuclear reaction F(19) (p, alpha gamma) O(16) to fluorine determination is outlined. Analysis in liquid and gaseous phases suffers from the need to use a proton transmission foil; in principle, solids can be analyzed inside the accelerator vacuum, but powder targets are handled more easily by using a foil. Sulfur hexafluoride diluted with xenon was used in gas mixture studies. Fluorine in gases can be determined at relatively high levels (5-100%) by a simple system that could easily be adapted, by the use of thicker foils and higher bombarding energies, to reach much lower levels. Determinations in liquids were carried out in the range 20 ppm to 10% of fluorine in aqueous solutions. Interferences are not important, except for aluminum and possibly lithium. The theoretical limits of detection are in good agreement with those observed in practice, being about 20 ppm for the particular background and experimental arrangement used. (Author abstract modified)

17128

Saltzman, Bernard E.

PREPARATION AND ANALYSIS OF CALIBRATED LOW CONCENTRATIONS OF SIXTEEN TOXIC GASES. Anal. Chem., 33(8):1100-1112, 1961. 20 refs.

The development and testing of analytical methods for the accurate determination of low concentrations of various toxic gases are described. All-glass flow systems were preferred for the dilution of gases with purified air, since such systems avoid serious errors from surface adsorption or reaction with impurities. Several practical flow dilution systems are described and diagrammed, as well as an asbestos plug flowmeter which was found useful for metering flows varying from a few hundredths of a milliliter to a few milliliters per minute; motor-driven glass syringes can also be used for metering gas (and liquid) flows in these ranges, but have the disadvantage of intermittent operation. Rotameters are convenient for metering gas flows greater than 10 ml/min, but becuase of calibration difficulties are considered secondary rather than primary measuring devices. In an evaluation of chemical analytical methods, it was found that many of the methods available were based on assumptions derived from studies conducted either at high gas concentrations or in liquid solutions; various difficulties are encountered when such methods are critically tested at low concentrations. The methods finally selected were first tested for sensitivity for samples of reasonable size· results consistent with both sample volume and test gas concentration; adequate absorption efficienty with the available sampling equipment; and adequate stability of reagents and final solutions. The role of sampling absorption efficiency is developed mathematically, and midget sampling equipment described. Finally, methods are given for each of the following gases: ammonia, arsine, bromine, carbon dioxide, carbon monoxide, chlorine, chlorine dioxide, ethylene oxide, hydrogen chloride, hydrogen cyanide, hydrogen fluoride, monoethanolamine, nitric oxide, nitrogen dioxide, phosgene, and stibine.

18016

Thomas, M. D. and R. E. Amtower

THE MICRODETERMINATION OF FLUORIDE IN VEGETATION. J. Air Pollution Control Assoc., 19(6):439-442, June 1969. 16 refs.

This paper describes a micro method for the determination of the fluoride content of plant materials, particularly the leaves. The samples are dried and ground to a fine powder. 50 mg. samples are burned in oxygen in 250, ml separatory funnels or in 300, ml Erlenmeyer flasks. The gaseous products of the combustion are absorbed in 0.1N NaOH in the closed funnel or flask and transferred to a small covered plastic dish in which the fluoride is diffused to tiny droplets of 3N NaOH solution distributed over the lower side of a tight fitting cover. The diffused fluodide is dissolved in water and determined colorimetrically by the SPADNS reagent. (Author's Abstract)

18230

Bredemann, G., and H. Radeloff

PERTAINING TO THE DIAGNOSIS OF DAMAGE INDUCED BY FLUORINE-FUMES. (Zur Diagnose von Fluor-Rauchschaden.) Translated from German. Phytopathol. Z., 5(2):195-206, (1932). 15 refs.

An analytical method of analysis to verify fluorine (F) damage to plants is needed because F action shows neither unique nor consistent symptoms. Fluorine compounds attack fruits or enter plants through leaf stomates and decompose into hydrofluoric acid, which then acts on the mesophyll or spongy parenchyma. Several microchemical methods are used for F determination, two of which are particularly suitable for qualitative detection in plants. In the color method of Feigl and Krumholz, F is indirectly identified by the analysis of a process distillate for volatile silicon fluoride. Here, silicon is identified by an analytical method imparting a blue color to the solution. The second method crystallizes F as Na2 Si F6. Both techniques are shown to be sensitive to small amounts of F, 0.005 mg and 0.05 mg per 100g of dry leaves, respectively, but the latter is simpler and more direct. Experiments with various plants show that in nearly every case neither method gives deceptive, false positive results from naturally present F. It appears possible, however, to get negative results for F presence from plants previously damaged by F in earlier stages of development and from fruits damaged by extremely small amounts of F. Experiments also show that plants exposed to soils with unusually large amounts of apatite or phosphate fertilizer containing fluorides do not pick up detectable amounts of A and show no F damage. Seed germination is inhibited when the concentration of a soluble fluoride (e.g. NaF) is between 0.1 and 0.5 percent. Conveniently, soluble F components from soil can only be detected in the few cases when toxic effects are present. Thus, the simpler

Na2SiF6 crystallization test is recommended for standard examinations, and the color test for cases where damage from a minute quantity of F is suspected and a negative crystallization test results.

18264

Oelschlaeger, W., and W. Woehlbier

EFFECTS OF FLUORINE. RESULTS OF INVESTIGATIONS WITH PLANTS AND ANIMALS. (Bestimmung von Fluor in pflanzlichen, tierischen und anorganischen Substanzen, sowie in Waessern und Luft.) Translated from German. Franklin Inst. Research Labs., Philadelphia, Pa., Science Info. Services, Contract No. CPA 22-69-30, Project No. C 2439, 31p., 1968. 41 refs.

In the method for determining fluorine which like most others is based on distillation according to Willard and Winter, all error sources have been eliminated which may exist during sampling, grinding, ashing, treatment of the ash, distillation, and concentration of the distillate. Furthermore, almost F-free calcium oxide has been prepared which must be added prior to ashing to a number of samples of animal origin. For the determination of fluorine, distilling equipment was used which operates automatically to a large extent, is easy to handle, and was developed in cooperation with the aluminum plant Rheinfelden. The apparatus for concentrating distillates with very low fluorine contents works almost automatically. The method was tested with various synthetic solutions as well as with a number of internationally conducted ring analyses over several years. Today the method together with the equipment is used in many laboratories both in this country and abroad for the determination of fluorine in organic, inorganic and other materials.

18283

Kahlert, Ernst and Willi Schneider

SYNERGISM BETWEEN FLUORINE EMISSION AND OTHER AIR POLLUTANTS. (Ueber den Synergismus von Fluorimmissionen mit anderen Verunreinigungen der Luft.) Text in German. Staedtehygiene (Uetzen/Hamburg), 20(4):82-85, April 1969. 11 refs.

Previous measurements of fluorine emissions in various locations at Duisberg had indicated that there was little correlation between fluorine concentrations and extent of plant damage. A new series of measurements at three locations conducted over a series of four years indicated that while the total fluorine emissions were at no time excessively high, the amount of plant damage varied with the percentage of soluble fluorine salts. The relative proportion of soluble salts in turn was a function of the pH, the lower the pH the higher the percentage of soluble salts. It is concluded that only the soluble fluorides are phytotoxic and hence that the total fluorine level is not a proper basis for forecasting potential plant damage.

18344

Harriss, Robert C., and Harold H. Williams

SPECIFIC-ION ELECTRODE MEASUREMENTS ON BR, Cl AND F IN ATMOSPHERIC PRECIPITATION. J. Appl. Meteorol., 8(2):299-301, April 1969. 10 refs.

Electrodes have been used to investigate sources of and variations in the halogen content of atmospheric precipitation from Hamilton, Ontario, an industrial city. A series of sampling stations was established in the area extending from the industrial center of the city to the agricultural area approximately 10 miles west. Samples of major snow accumulations and rain were collected in January, March, and June 1968. In March 1968, multiple samples were collected at individual sites to investigate time dependent variations in snow chemistry. Bromide and fluoride were determined using specific ion electrodes. Chloride determinations were made with a silver billet electrode and by mercuric nitrate titration with diphenyl-carbazone indicator-buffer. The reference electrode used was a dual-glass junction saturated calomel. A vibrating reed electrometer was used to measure changes in potential develope by the electrode pairs. There is a large variation in concentratio ranges of all the halogens analyzed. In two of the January storms the fluoride concentration is more than an order of magnitude higher in precipitation from the industrial area than in the surrounding agricultural areas, indicating a local source of pollution. One sample which represents the last precipitation of the storm, has a high Br/Cl ratio indicating the Cl is removed in the early precipitation. The range in halogen concentration for rain samples was very similar to the data presented for snow. From these preliminary studies, it can be concluded that specific ion electrodes provide a rapid, precise, and relatively inexpensive method for the analysis of bromide, chloride, and fluoride in atmospheric precipitation.

18696

Zolty, Seymour and Manfred J. Prager

DETECTION OF SUB-PPM QUANTITIES OF CHLORINE TRIFLUORIDE IN AIR BY ELECTRON CAPTURE GAS CHROMATOGRAPHY. J. Gas. Chromatog., 5(10):533-535, Oct. 1967. 9 refs. (Presented at the American Chemical Society, National Meeting, 152nd, Division of Water, Air and Waste Chemistry, New York, Sept. 1966.)

The Storage in naval vessel magazines of missiles supplied with liquid propellants requires the development of rapid automatic detection systems to provide adequate warning of the presence in shipboard spaces of hazardous concentrations of toxic vapors from such propellants. The applicability of gas chromatography to the detection of the propellant oxidizer chlorine trifluoride in air was studied. Sub-ppm concentrations in a 1-cubic centrimeter air sample introduced directly into the chromatograph without requiring time-consuming concentration procedures could be detected rapidly with an electron capture detector. A linear response was obtained in the range of 0.05 to 1.0 ppm volume and detectability of less than 0.01 ppm was indicated. A sample introduced into the chromatograph by an automatic gas sampling valve was detected by monitoring a peak with a retention time of 0.95 min. Details of apparatus and operating procedures are given. The method is suitable for automatic, continuous monitoring of hazardous environments such as laboratory, plant, and shipboard storage areas. (Author abstract modified)

19076

Bohlander, R. F.

AUTOMATIC STEAM DISTILLATIONS OF FLUORIDE INTO SMALL VOLUMES. Preprint, National Lead Co. of Ohio, Cincinnati, 15p., Feb. 7, 1969. 4 refs. (Presented at the Pittsburgh Conference on Analytical Chemistry and Applied Spectroscopy, Cleveland, Ohio, March 2-7, 1969, Paper NL-CO1039.)

A rapid method is described for separating fluorides from interfering ions without excessive dilution, in which a controlled-temperature Willard-Winter type still is combined with a new distillate recycler. Fluorides are trapped out of the distillate with thorium, after which the distillate is boiled and the steam reintroduced into the still. In this manner, the fluorides are removed from the samples in 20 minutes and isolated in a form that requires no further preparation prior to the

color development. The apparatus developed for this distillation is relatively simple and inexpensive, and the fluorides are separated into less than 20 ml of distillate. Fluoride concentrations of less than 1 microgram/ml can be determined accurately. The recycling still is especially well suited for the determination of micro quantities of fluoride in samples containing large amounts of interfering materials. The small volume of distillate produced makes the apparatus several times more sensitive than ordinary Willard-Winter type stills. It has no boiler to fill and no receiver cup to overflow if forgotten. Because of automatic temperature control, automatic timing, and automatic shutdown features, very little of any analyst's time is required for operation. (Author abstract modified)

19500

Onichi, S., S. Ito, and M. Zuzuki

STUDIES ON HYGIENIC CHEMISTRY OF AIR POLLUTION (I). MEASUREMENT OF FLUORIDE IN THE AMBIENT AIR. (Taikiosen booshitsoo no eiseikagakoo ni kansooloo kenkyu (I) Taiki chu no fookkabootsoo no sokootei ni tsoolte). Text in Japanese. Taiki Osen Kenkyu (J. Japan Soc. Air Pollution), 4(1):112, 1969. (Proceedings of the Japan Society of Air Pollution Annual Meeting, 10th, 1969.)

To give a basis for measuring fluorides in air, which may be discharged from aluminum, fertilizer, glass, and soda industries and influence especially plants, the following experiments were performed, using the lanthanum -ALC method for quantitative analysis. For gaseous fluorides, first the effect of concentrations of dilute sodium hydroxide solution (the absorbent), its absorbing velocity, and absorbed amount on the collection efficiency were examined. Secondly, to know the extent of the interference by other ions coexisting in samples, separation by distillation with several kinds of reagents, like phosphoric acid-perchloric acid, silica-perchloric acid or sulphuric acid-silver sulphate, was tested. The temperature determined the amount of separated fluorides and the removable interfering ions. The sampling of particle fluorides usually involves filters, some of which, include fluorides in a considerable amount, which require to be eliminated before quantitative analysis.

20030

Wyszynska, Halina, Konrad Kosinski, Stefan Maziarka, Zbigniew Misiakiewicz, and Artur Strusinski

METHODS OF STUDY OF ATMOSPHERIC AIR FROM THE HYGIENIC POINT OF VIEW. (Metody sanitarnego badania powietrza atmosferycznego). Text in Polish. Wydawnictwa Metodyczne Panstwowego Zakladu Higieny (Methodologic Study Govt. Dept. Hyg.). no. 10, 141p., 1968. 82 refs.

Methods of determining pollutants, the admissible concentration of which was limited by Polish legislation, and determining a number of other atmospheric pollutants which in excessive amounts are either hazardous to health or cause damage by corrosion are reviewed. Determination of air dustiness, chemical analysis of dust, and determination of sulfur dioxide, sulfur trioxide, carbon disulfide, nitrogen dioxide, nitric oxide, fluorine, chlorine, hydrogen chloride, ozone, phenol, benzene, chlorbenzene, and aniline are presented. A description of each method includes principles of the method, its limitations, a description of the apparatus, procedure of sample collection, and data evaluation. The apparatus required usually are not expensive and complicated, but they have to be precise and well calibrated because of the extremely low concentrations measured. The reagents used have to be of high purity. Most of the methods described were verified and tested on the laboratory scale and in routine determination of pollution. Thus no difficulty should be encountered in their application.

20540

Ivie, James O., D. Thomas, Moyer, and Leonard F. Zielenski

AUTOMATIC SENSING AND RECORDING OF AIR POLLUTANTS ON CITRUS TREES. Biomed. Sci. Instrum., vol. 1:45-52, 1964. 6 refs. (Presented at the First National Biomedical Sciences Instrumentation Symposium, Los Angeles, Calif., June 14-17, 1963.)

Various instrument techniques used for measuring and for controlling air pollutants with respect to experiments with citrus trees in Southern California are described. The automatic punch card recording system is used to record date, time of day, plant transpiration, apparent photosynthesis by carbon dioxide exchange, nitrogen dioxide, nitric oxide, ozone, total oxidants, hydrogen fluoride, temperature, and integrated light recording. The punch card recording permits automatic handling of data on the IBM 1620. The master timer and valve control unit controls operation of the CO2 and moisture analyzers. It collects 30 min inlet and outlet air samples from 12 plots. These samples are stored in plastic bags and in the succeeding 30 min are fed into the CO2 infrared analyzer and a humidity analyzer. Oxides of nitrogen are recorded continuously by a colorimetric method based on a diazotization reaction with the Griess-Saltzman reagent. Ozone as well as other oxidants are also measured colorimetrically by the potassium iodide reaction. Hydrogen fluoride is determined by observing the quenching of the fluorescence on magnesium oxinate impregnanted filter paper tape. An Eppley pyrheliometer is used to measure the light received on a horizontal surface. Twelve temperatures are recorded by the logger directly by thermocouples connected to the input of the scanner.

20595

Wyszynska, Halina, Konrad Kosinksi, Stefan Maziarka, Z. Misiakiewicz, and Artur Strusinsky

METHODS FOR THE SANITARY INVESTIGATION OF ATMOSPHERIC AIR DEVELOPED BY THE SECTION OF SANITATION LABORATORIES FOR THE PROTECTION OF ATMOSPHERIC AIR. (Metody sanitarnego badania powietrza atmosferycznego opracowanie zespolu Pracowni Sanitarnej Ochrony Powietrza Atmosferycznego). Wydawnictwa Metodyczne Panstwowego Zakladu Higieny (Methodologic Study Govt. Dept. Hyg.), no. 4(26); issue no. 10, 149p., 1968. 78 refs. Translated from Polish. Franklin Inst. Research Labs., Philadelphia, Pa., Science Info. Services, Oct. 14, 1969.

Methods are presented for determing atmospheric pollutants, with the exception of carbon monoxide and gasoline, the concentrations of which are defined by Polish law. In addition, methods are given for the determination of pollutants present in the atmosphere in quantities sufficient to create sanitation problems or to cause plant damage and corrosion to buildings. Some of the methods have been checked and tested extensively in the laboratory and in the field. Others have not yet been widely tested but are included for their potential usefulness in laboratory studies. The methods include the measurement of dust collected by the deposition method with respect to tars, sulfates, free silica, heavy metals, calcium, and fluorine. The other methods are the aspiration and contact methods for sulfur dioxide; the method employing thorium nitrate and eriochromecyanin R for sulfur trioxide-sulfuric acid; the para-aminodimethylaniline method for hydrogen sulfide; methylene blue and diethylamine and copper methods for carbon disulfide; the Saltzman method for nitrogen oxides; titration with thorium nitrate and colorimetric determination with eriochromecyanin and zirconium oxychloride for fluorine; o-tolidine for chlorine; titration for hydrogen chloride; buffered potassium iodide and the Heigal method for ozone; the Schryver method for formaldehyde; para-aminodimethylaniline

and diazo-p-nitroaniline for phenol; nitration for benzene and chlorobenzene; and the indophenol method for aniline.

20650

Kimoto, T. and M. Sakauchi

ULTRAVIOLET ABSORPTION FOR SO2 STACK MONITOR. (Shigaisen kyushuho ni yoru aryusan gasu sokuteiho ni tsuite). Text in Japanese. Taiki Osen Kenkyu (J. Japan Soc. Air Pollution), 4(1):25, 1969. (Proceedings of the 10th Annual Meeting of the Japan Society of Air Pollution, 1969.)

An exposition is presented of a high-concentration sulfur dioxide monitoring device that can also be applied toward environmental air quality measurements. The apparatus essentially depends on the absorption of ultraviolet light by sulfur dioxide at the wavelengths in the range of 280 to 305 millimicrons where there is a large depression in the absorption spectra. The specification of the device as well as the diagram of the electrical connections of various components are presented. By changing the wavelength specification of the device, other gases such as nitrogen dioxide, hydrogen sulfide, acetone, benzen, ammonia, fluorine, chlorine, bromine, and methylformaldehyde can be measured. The test run showed that there was little interference from substances such as nitrogen dioxide, steam, and carbon dioxide; the linearity of the concentration versus the meter swing was good. The zero-span drift was minimal and the response speed was around 90% in a minute interval, depending on the flow rate.

20701

Yu, Ming-Ho and Gene W. Miller

GAS CHROMATOGRAPHIC IDENTIFICATION OF FLUOROORGANIC ACIDS. Environ. Sci. Technol., 4(6):492-495, June 1970. 9 refs.

Gas chromatographic techniques are described for the separation and identification of fluoroacetate and fluorocitrate from fluoride injured plant tissue and organs of animals suffering from severe fluorosis. Methylfluoroacetate was prepared from monofluoroacetate, and trimethylfluorocitrate was prepared from monofluorocitrate. Samples of crested wheat grass were collected within 2 miles of an industrial phosphate plant, air-dried, and ground in a mill. Plants grown in a greenhouse in the absence of fluoride were used as controls. Kidneys and hearts were obtained from horses and cattle showing severe fluorosis. Tissue was extracted with 95% ethanol in a Soxhlet apparatus. The methyl esters of organic acids were separated in columns packed with 10% polyethylene glycol 6000 or 10% Reoplex 400 on Chromosorb W solid phase using a flame ionization detector. The results indicate the presence of fluoroacetate and fluorocitrate in forage crops collected near the phosphate plant. This suggests that atmospheric fluoride may be incorporated by plants into the organic form with the formation of toxic fluoroacetic and fluorocitric acids.

20778

West, Philip W., George R. Lyles, and Jimmy L. Miller

SPECTROPHOTOMETRIC DETERMINATION OF ATMOSPHERIC FLUORIDES. Environ. Sci. Technol. 4(6):487-491, June 1970. 11 refs.

The lanthanide-alizarin complexan-fluoride reaction was investigated and an improved procedure for the spectrophotometric determination of atmospheric fluorides was derived. The suggested sampling procedure eliminates the interference of diverse ions and molecules commonly present in the atmosphere. The method involves adding standard fluoride, 10.0 ml of alizarin complexan, 10.0 ml of Ce(III), 25.0 ml of acetone, then diluting to 100 ml. The test solution is allowed to stand for 90 min, after which absorbance is determined at 618 micrometers, using 1-cm curvettes. The method has a sensitivity of 0.0019 microgram fluoride per sq cm and is reproducible within plus or minus 0.003 microgram per ml at the 95% confidence level for known fluoride concentrations of 0.400 microgram per ml. The procedure is uniquely suitable for the determination of actual fluoride concentrations in ambient atmospheres at ppb levels. (Author abstract modified)

20892

Durst, R. A.

ANALYSIS OF MISCELLANEOUS MATERIALS. I. DETERMINATION OF FLUORIDE IN DUST SAMPLES. National Bureau of Standards, Washington, D. C., Microchemical Analysis Section, TN-505 p. 83-84, Oct. 1969.

The versatility of the fluoride ion-selective electrode was demonstrated by its application to the determination of fluoride in a sample dust. The analysis of fluoride in the sample was performed using combustion in an oxygen flask. Three determinations were made on 0.2 to 0.3 g samples. The mean sensitivity of the method was 88 ppm. The oxygen flask employed was a polycarbonate flask. Diethylene glycol was added to the sample to aid combustion. The absorbant was a potassium nitrate solution. A fluoride ion-selective electrode and a plastic silver-silver chloride reference electrode were used for the direct potentiometric determination of the fluoride. The electrode system was calibrated with standard fluoride solutions from 0.001 to 0.00001 M.

20895

Durst, R. A

CONSTRUCTION AND CHARACTERISTICS OF A FLUORIDE ION-SELECTIVE MICROELECTRODE. National Bureau of Standards, Washington, D. C., Microchemical Analysis Section, TN-505, p. 79-82, Oct. 1969.

The feasibility of constructing a fluoride microelectrode suitable for studies of microliter volumes of sample solutions was demonstrated. Although still about two orders of magnitude larger than the smallest glass electrode, further miniaturization of the electrode is possible along lines that could lead to intracellular fluoride determinations. The microelectrode is constructed from a polyethylene tubing drawn out to a 2-mm neck at the lower end. In its final form, the microelectrode tip is an exposed conical portion of lanthanum fluoride crystals of approximately 1.5 microliter volume. The crystal is insulated with polystyrene coil dope. The electrode employs a silver-silver chloride internal reference electrode and a NaF-KCl (each 0.1M) reference solution. The response of the electrode to fluoride activity deviated from Nernstian response in the micromolar range, but was 59.5 mV/pF in the more concentrated solutions. All measurements were made on macro volumes of stirred solutions (approximately 25 ml) against a normal-size saturated calomel electrode. By using the microfluoride electrode in conjunction with a microcapillary reference electrode, measurements could be made on 2-microliter volumes.

21156

Reusmann, Guenther and Juergen Westphalen

AN ELECTROMETRIC METHOD FOR DETERMINING THE FLUORINE CONTENT IN PLANT MATERIAL. Staub (English translation from German of: Staub, Reinhaltung Luft), 29(10):18-20, Oct. 1969. 17 refs.

A method for determining fluoride concentrations in plant materials is described. The sample is ashed and fused with sodium hydroxide. After the addition of a citrate buffer, the solution is pumped through the cells of four fluoride crystal-membrane measuring electrodes. The liquid flow recombines in the cell of a calomel reference electrode filled with sodium citrate-sodium chloride. This reference electrode exhibits a more steady potential than those filled with potassium chloride. The fluoride potential is then recorded on a digital pH meter. In order to determine the influence of interferring ions, different salt additives were added to 50 ml of a calibration solution with a concentration of 1.10 to the minus fourth power N/F(-) and the change of the potential measured.

21730

Marshall, B. S. and R. Wood

A SIMPLE FIELD TEST FOR THE DETERMINATION OF HYDROGEN FLUORIDE IN AIR. Analyst, vol. 93:821-826, Dec. 1968. 6 refs.

A field method is described for determining hydrogen fluoride vapor in air at concentrations up to 20 micrograms of hydrogen fluoride per liter. The gas is collected in an acidic solution of zirconium-Solochrome cyanine R reagant and the observed bleaching of the color is compared with standards. The apparatus used is simple to operate and the time required for a determination is less than 5 min. However, in view of the interfering effects of aluminum and phosphate, the field test is not recommended for the testing of industrial atmospheres polluted with fluoride-containing dusts. (Author abstract modified)

21806

Okita, T., R. Sugaoi, and K. Kaneda

MEASUREMENT METHOD OF ATMOSPHERE HYDROGEN FLUORIDE BY FILTER PAPER IMPREGNATED WITH ALKALI. (Alkali loshiboh ni yo oo taiki chu hookkasoolso no sokooteiboh). Text in Japanese. Taiki Osen Kenkyu (J. Japan Soc. Air Pollution), 4(1):111, 1969. (Proceedings of the Japan Society of Air Pollution Annual Meeting, 10th 1969.)

Atmospheric hydrogen fluoride (HF) determination with sampling by alkalized filter paper was examined. Alkalized filter papers are prepared by soaking filter papers of about 5 cm in diameter in 10.5 and 1% of Na2CO3 and K2CO3 solution and drying them in a dryer for 2 hours. Their collection efficiencies are obtained using a setup, which consists of an HF generator (HF permeation tube and diluted hydrofluoric acid), thermometers, two pieces of filters prepared in the above manner, a flowrator, and a pump, in this order. Concentrations of HF are varied from 0.005 to 1.00 ppm with a flow rate of 5, 10, 15, and 20 l/min. These filter papers undergo extraction by water to produce sample solutions, to which are added 10% Alfusson and acetone; their light absorption rates are measured. The collection efficiencies of filter papers do not show significant differences between done impregnated with Na2CO3 and one with K2CO3, within the concentration ranges of HF tested, and also with the flowrates used. However, alkali of higher concentration tends to decrease the light absorption rate. HF of more than 0.005 ppm can be determined by this method with the following conditions: 1% Na2CO3 or K2CO3 for alkali, 20 l/min for flowrate, and 120 minutes for sampling time. This method shortens the sampling time required by the impinger method by one-tenth.

21855

Mori, M., S. Ito, and H. Ogino

AUTOMATIC MEASUREMENT OF HYDROGEN FLUORIDE IN AIR BY COLORIMETRIC METHOD. (Taiki chu fookka soolso no lenzokoo sokooiei). Text in Japanese. Taiki Osen Kenkyu (J. Japan Soc. Air Pollution), 4(1):113, 1969. (Proceedings of the Japan Society of Air Pollution Annual Meeting, 10th, 1969.)

The automatic measuring method of a small amount of fluorides developed by Adams et al (1959), which uses a zirconium- eriochrome cyanine-R method modified by Megregian is modified to reduce sampling volume through an increase in sensitivity of the colorimetry. To do this, a little lower dosage of reagent is used than the original method, a concentration of hydrochloric acid which gives a relatively small variation in the absorption spectrum of the agent, and 556 millimicron of the measuring wave length for the instrument. The time-variation of the indicated color is stable enough to permit intermittent measurements in an hour. As far as interferring substances are concerned, Al(3)(+) and CO4(2)(-) do not give any significant influence for the measurement in air.

21881

Chapron, Yves, Genevieve Faltot, Henri Francois, and Anne-Marie Grand-Clement

PROCEDURE FOR DETERMINING THE ATMOSPHERIC CONTENT OF GASEOUS POLLUTANTS, AND A MEASURING CELL FOR THE APPLICATION OF THIS METHOD. (Procede pour determiner la concentration d'une atmosphere en gaz polluants et cellule de mesure pour la mise en oeuvre du procede). Text in French. (Commissariat a l'Energie Atomique, Paris (France).) Swiss Pat. 450,763. 4p., Jan. 31, 1968. (Appl. June 9, 1965, 6 claims).

A procedure is described for continuous determination of the atmospheric content of halogens, halogen acids, hydrocyanic acid, and gaseous cyanide derivatives. Measurement is via an electric current proportional to the concentration, which is generated in an electrolyte previously exposed to the air to be measured and contained in an electric cell. The device has a wide range of measurement. It can detect quantities of fluorine dissolved in the electrolyte in the range 0.2-150 micrograms per milliliter. This corresponds to an atmospheric concentration of hydrogen fluoride between 0.05 micrograms per liter and 35 micrograms per liter. Further refinement could increase the sensitivity to 0.025 micrograms per liter of HF in the atmosphere. One electrode of the detecting cell is made of aluminum, silver, or platinum, while the second electrode is made of stainless steel and is internally coated with platinum or nickel. The cell is designed with a concave structure of the electrodes, permitting a large surface of exposure to the electrolyte.

22458

Hertzog, D.

AUTOMATIZATION OF CHEMICAL ANALYSES OF THE POLLUTION CONTROL LABORATORY. (Automatisation des analyses chimiques du laboratoire de controle de pollution). Text in French. Technicon (France), Services Industriels, p. 3, 1970 (?).

An automatic analyzer, 'Auto Analyzer' is described. The 'Auto Analyzer' can operate on a succession of samples or continuously and incorporates a peristaltic proportioning pump which allows the introduction of samples at a constant rate and their continuous mixing with the specific reagents required for the analysis. The samples are conveyed to different

modules in which specific chemical operations are performed. Such as mixing of the reagents, continous filtration incubation, heat conditioning distillation, extraction, and phase separation. The result of each reaction is measured by a differential colorimeter the readings of which are continuously recorded. In the laboratory, 10 to 40 samples per hour can be analyzed. In continuous operation, the different fluids to be analyzed are introduced successively into the Auto Analyzer by a set of electrically operated valves controlled by a programmer. One to twelve channels can be controlled during a one-hour cycle. At intervals, a calibrating sample is introduced and measurements obtained on it are used to correct automatically the routine measurements. An analysis program can be changed to another within less than 30 minutes. The used methods of determination of ammonia, cyanides and oxygen are briefly outlined. Among the automated analyses, the following are cited: hardness, alkalinity, sulfates, nitrates, nitrites, ammonia, chlorides, iodides, cyanides, fluorides, phosphates (alkaline and alkaline-earth), metabolic substances, phenols, aldehydes, DCO, and detergents.

22517

McCaldin, Roy O.

ACCEPTABLE EQUIPMENT AND PROCEDURES-FOR EVALUATING AIR POLLUTION PROBLEMS. Preprint, Industrial Hygiene Foundation of America, Inc., Pittsburgh, Pa., 11p., 1960. 17 refs. (Presented at the Industrial Hygiene Foundation, Engineering Conference, Oct. 27, 1960.)

When choosing equipment to make air quality measurements, it is necessary to estimate the possible pollutants as well as the degree of accuracy and thoroughness with which they must be measured. Availability and reliability of equipment, cost of operation, and skill required for satisfactory results are also factors to be considered in equipment choice. The hi-volume sampler, which consists of a vacuum cleaner motor with suitable mounting to accommodate an 8 by 12-in. filter, is frequently used to measure suspended particulates which may consist of smoke, dust, or other solids sufficiently small to remain airborne for long periods of time. Fiber glass filters commonly used with this sampler collect practically all particulates down to 0.3 micron in diameter, while the simplest analysis is that for total weight of material collected on the filter. Results of analysis of suspended particulate samples collected from 1953 to 1957 by the National Air Sampling Network are presented tabularly. Automatic strip filter paper samplers commonly use a diaphragm pump to draw air through a portion of the filter tape at a sampling rate of about seven liters per minute. The amount of smoke or other suspended particulate collected with this type equipment shows up as various shades of gray; light transmission, sampling time, and flow rate are used to compute results. A major modification in this type of sampler employs a membrane filter tape instead of Whatman filter paper. Laboratory gas washing bottles, bubblers, impingers, and midget impingers are used with a wide variety of both commercial and home-made equipment for collecting gas samples. The Thomas Autometer and Titrilog are designed for determination of sulfur compounds; the MSA Lira uses infrared absorption measurements to determine carbon monoxide concentrations in air; and the Kruger apparatus has been used to measure nitric oxide and nitrogen dioxide. Dustfall samplers are designed to collect the coarse particulates and droplets which settle out more or less rapidly near sources of emission. The lead peroxide candle sampler provides a simple, economical method of estimating sulfation rates of the ambient atmosphere. Hydrogen sulfide will blacken lead bearing materials, and this principle has been employed to estimate its presence in the atmosphere. Some of the corrosive effects of pollutants may be evaluated by a test based on weight gain that occurs when a thin iron disc is exposed to the atmosphere. Lime-treated filter papers have been used to determine comparative fluoride levels in the environment.

22812

Wohlers, H. C. and G. B. Bell

LITERATURE REVIEW OF METROPOLITAN AIR POLLUTANT CONCENTRATIONS-- PREPARATION, SAMPLING AND ASSAY OF SYNTHETIC ATMOSPHERES. (FINAL REPORT). Stanford Research Inst., Menlo Park, Calif., Contract DA 18-064-404-CML-123, S.R.I. Proj. SU-1816, 193p., Nov. 30, 1956. 82 refs.

A literature review of metropolitan air pollutant concentrations and of the preparation, sampling, and assay of synthetic atmospheres is presented. Measured concentrations of gaseous and particulate pollutants in the atmosphere, including sulfur dioxide, hydrogen sulfide, nitrogen dioxide, ammonia, formaldehyde, hydrocarbons, chloride, carbon monoxide, ozone, fluoride, hydrogen fluoride, carbon dioxide, gross particulates, and dust fall are tabulated. Calculated emissions from centers of population are presented for industrial and public processes, including combustion of coal, oil, and natural gas, incinerators, automobile exhausts, power plants, and metallurgical operations. Data on measured and calculated air pollution concentrations throughout the world are given. Methods for injecting pollution simulants into a test chamber, such as ozone generators and aerosol despensers, are mentioned. Sampling and analytical procedures are described for the particular problem of testing static atmospheres for bacteria. Sampling equipment consists primarily of an impinger preceded by a millipore filter. Analytical procedures include ultraviolet absorption, high volume sampling, glass fiber filters, and colorimetric, gravimetric, iodimetric, spectrophotometric, Saltzman, and electrochemical methods.

22877

Stuttgart Univ. (West Germany), Inst. fuer Verfahrenstechnik und Dampfkesselwesen

KEEPING THE AIR PURE. (Reinhaltung der Luft). 58p., 1968. 25 refs. Translated from German. Belov and Associates, Denver, Colo., 80p., Feb. 5, 1970.

A review of technical articles relating to air pollution is presented. Sampling techniques and statistical evaluation of results are discussed. The effects of gaseous impurities on humans and plants are briefly mentioned. Maximum emission values for nitric oxide, nitric acid, chlorine, hydrogen chloride, hydrogen sulfide, and sulfur dioxide are tabulated. Measurement methods, including filters, absorption bottles, and various continuous methods are described. SO2 is generally measured by the silica gel method, the West Gaeke method, the 'Ultragas 3' method, the Pico-flex instrument, or by infrared spectrophotometry. Isopropanol is a good absorption medium for sulfur trioxide. Dewpoint measurement and detectors are mentioned. NO2 can be measured by the Saltzman method, and by photometric or colorimetric means. Measurement of H2S and fluorine emissions may be done by the sodium hydroxide method. Methods for carbon monoxide and dioxide are mentioned. Organic compounds are measured by gas chromatography. Methods for measuring and counting dust contaminants, and stack sampling are discussed. Optical and electrostatic methods of determining smoke shade are described. The Konimeter, impinger, and dust fall methods are considered. A disucssion of plume behavior, including stack height, turbulence, diffusion, and winds, is presented. Several laws regarding emissions are mentioned.

22879

Adams, D. F., H. J. Dana, and R. K. Koppe

REPORT ON THE 'UNIVERSAL' AIR POLLUTANT ANALYZER. Washington State Univ., Pullman, Inst. of Technology, P.H.S Contract 66512, 37p., Sept. 4, 1957. 26 refs.

The development, design, and construction is described of a basically versatile automatic instrument system potentially applicable to the sampling, analysis, and recording of levels of any atmospheric pollutant for which colorimetric methods are available or can be devised. Conditions which may be easily varied include air sampling rate, reagent, light wave band from short ultraviolet through the visible range, reagent flow rate, temperature of the air-reagent contactor system, and optical system. The design is suitable for producing dosimeter or continuously integrated records; a prototype analyzer was constructed for each recording method, although the instrument is basically intended as a dosimeter, based on the varying time span necessary to accumulate equivalent pollutant concentrations. The Zirconium-Eriochrome Cyanine R reagent for fluoride and the Starch-Iodine Blue reagent for sulfur dioxide were modified for use in the analyzers. The reduced stability of these reagents under continuous air aeration for periods exceeding 4-12 hrs limits the pollutant concentration which may be accumulated by a single reagent charge. This appears, however, to be desirable from the viewpoint of field application. In field testing, simultaneous comparisons were made with commercially available instruments for sulfur dioxide and hydrogen sulfide. The dosimeter showed greater sensitivity of these two pollutants than the other instrumental methods. Recommendations are included for farther research/study in seven areas to improve the accuracy, versatility, and reliability of the system and to reduce its cost.

23096

Vittori, Ottavio

RESEARCH IN CHEMICAL COMPOSITION OF SOME FORMS OF ATMOSPHERIC PARTICLES. Chicago Univ., Ill., Dept. of Meteorology, NIH Grants RG-4521 and S-12(C), TN-5, 54p., Dec. 15, 1956. 16 refs.

Procedures are described for identifying the chemical composition and size of airborne particles. The basic technique involves the capture of the particles in a specially treated gel. Reagents in the gel produce a physico-chemical reaction known as the Liesegang reaction. The products of the reaction precipitate in the form of rings. Identification of the particles is made by one or more of three factors: the character of the pattern of the precipitate, the color of the precipitate, or its change of color. Tests were developed for particles containing the following substances: chlorides, soluble iodide, soluble sulfide, soluble ferrocyanide, soluble sulfates, nitrates, potassium ion, soluble silver, fluorides, lead and all heavy metals. Details are given for the preparation of the gels to be used for specific tests, and techniques for the capture of particles are discussed. (Electrostatic precipitation, impactor, and millipore filter). Experiments conducted to study the production of sulfate particles by the burning of wood or coal are discussed briefly, and a technique for the capture of small water droplets and analysis of the salt which may be dissolved in them is described. (Author abstract modified)

23162

Meador, Marston C. and Robert M. Bethea

SYRINGE SAMPLING TECHNIQUE FOR INDIVIDUAL COLORIMETRIC ANALYSIS OF REACTIVE GASES. Environ. Sci. Technol., 4(10):853-855, Oct. 1970. 11 refs.

A flow apparatus for continuously producing small quantities (up to 280 l/hr) of humidified air containing known amounts of atmospheric contaminants is described. Contaminant levels up to 400 ppm nitrogen dioxide, sulfur dioxide, and chloride are reproducibly maintained for periods in excess of eight days by use of Teflon permeation tubes filled with the desired material. A comparison of the standard bubbler technique and glass and polyprophylene syringe gas sampling showed the polypropylene syringe technique to be superior for NO2 analysis (0.07-60 ppm) by the Lyshkow-modified Saltzman method. The improved syringe technique was extended to th colorimetric analysis of SO2, Cl2, and hydrochloric and hydrofluori acids in dynamically polluted air. The Lyshkow method for SO2 is applicable in the range 0.17-50 ppm. The orthotolidine method for free chlorine is applicable in the range 0.12-50 ppm. The modified method of Iawaskai, Utsumu, et al, for HCl is satisfactory for 0.5-50 ppm HCl. The bleaching reaction of Andrew and Nichols is marginally acceptable for 5-50 ppm HF. (Author abstract modified)

23286

Zwenig, Eugene A.

PRELIMINARY ASPECTS OF AN AIR POLLUTION PROBLEM. Florida Univ., Gainesville, Coll. of Engineering, Thesis (M.S.), June 1954, 96p. 106 refs.

A project intended to determine a practicable method of fluoride appraisal in micrograms/cu l of air is reported. The meteorologica considerations involved are discussed, and definitions and assumptions are established pertaining to the interrelationship of the atmospheric transport mechanism and field sampling results. A sampling plan and sampling method are described. Laboratory techniques for the analysis of samples and the elimination of interferences are detailed. Two analytical methods, thorium- alizarin titration and spectrophotometry, are concluded to be useful as potential standard techniques, but neither is established as adequate. The principal conclusion offered is that more work is required in all areas. Fluoride measurements obtained in the vicinity of an unidentified potential pollution source and from control stations in areas presumed to be free of fluoride pollution are presented tabularly. Control station readings are uniformly zero while the test station readings range from 0 to 2.6 micrograms/cu l.

23517

Bailey, J. J. and D. G. Gehring

DETERMINATION OF TRACES OF SULFUR, FLUORINE, AND BORON IN ORGANIC MATERIALS BY OXYGEN BOMB COMBUSTION. Anal. Chem., 33(12):1760- 1762, Nov. 1961. 12 refs. (Presented at the conference on Analytical Chemistry and Applied Spectroscopy, Pittsburgh, Pa., Feb. 1961.)

A platinum-lined Parr oxygen calorimeter bomb was successfully employed for quantitative decomposition of organic samples. Water is introduced into the bomb prior to combustion and the resulting combustion products are absorbed in the water. This aqueous liquid may then be analyzed for trace quantities of the desired cation of anion by standard microanalytical methods. The technique permits the combustion of a much larger sample (one gram) than the oxygen flask method. Results of trace analyses of synthetic fluoride, boron, and sulfur samples are presented in tabular form. Exceptionally good results were obtained for sulfur.

23518

Kelso, Foymae S., John M. Matthews, and Harry P. Kramer

ION-EXCHANGE METHOD FOR DETERMINATION OF FLUORIDE IN POTABLE WATERS. Anal. Chem., 36(3):577-579, March 1964. 6 refs.

A simple, accurate, and rapid ion-exchange method is described for removing interferences from waters containing low concentrations of fluorides. The method is based on the adsorption of fluoride in an acetate resin slurry, formation of a beryllium-fluoride complex, and removal of the adsorbed fluoride by a beryllium- eluting solution. With this technique, 20-30 water analyses a day can be performed with a precision and accuracy of plus or minus 0.1 mg/l. Thus the results obtained by the method are comparable to those for standard distillation procedures. The saving in time and equipment is considerable.

23546

Cralley, L. V., L. V. Haff, A. W. Hook, E. J. Schneider, J. D. Strauther, C. R. Thompson, and L. H. Weinstein

TENTATIVE METHOD OF ANALYSIS FOR FLUORIDE CONTENT OF THE ATMOSPHERE AND PLANT TISSUES (MANUAL METHODS). 12204-01-68T. Health Lab. Sci., 6(2):64-83, April 1969. 22 refs.

General precautions are given when analyzing for fluoride to prevent contamination by extraneous fluoride from such sources as sampling and laboratory apparatus, reagents, and from exposure to laboratory dust and fume. Directions are outlined in detail for sample preparation of particulate fluorides, gaseous fluorides (dry and wet collectors), and vegetation. Five analytical methods are described: isolation of fluoride by Willard-Winter distillation, ion exchange, and diffusion, and fluoride determination by titrimetric and spectrophotometric techniques. For each of these, the principle of the method, range and sensitivity, interferences, precision and accuracy, apparatus, reagents, and laboratory procedure are given, as well as calibration and standards, calculation, and effects of storage. The method is termed tentative until it is adopted as standard.

23547

Cralley, L. V., L. V. Haff, A. W. Hook, E. J. Schneider, J. D. Strauther, C. R. Thompson, and L. H. Weinstein

TENTATIVE METHOD OF ANALYSIS FOR FLUORIDE CONTENT OF THE ATMOSPHERE AND PLANT TISSUES (SEMIAUTOMATED METHOD). 12204-02-68T. Health Lab. Sci., 6(2):84-101, April 1969. 23 refs.

A method described for the analysis of fluorides wherein the suspended digest and sulfuric acid are pumped into a Teflon coil of a microdistillation device maintained at 170 C. A stream of air carries the acidified sample rapidly through a coil of Teflon tubing to a fractionation column. The fluoride and water vapor distilled from the sample are swept up the column into a condenser, and the condensate passes into a small collector. The distillate is pumped continuously from the sample collector and is mixed continuously with alizarin fluorine bluelanthanum reagent. The colored stream passes through a 15-mm tubular flow cell of a colorimeter, and the absorbance is measured at 624 millimicrons. The impulse is transmitted to a recorder. The colorimetric and distillation systems of the method are discussed. The normal range of analysis is from 0.1-4.0 micrograms F/ml, although the upper limit can be extended with modified procedures. The standard error or a single determination is between 2 and 8 micrograms, depending on the kind of plant tissue and the level of fluoride. Indirect accuracy determinations show no significant deviations from linearity. Frequent checks for precision and accuracy of the method are required. Details are given of interferences, apparatus, reagents, procedure (including tissue preparation, ashing and alkali fusion, automated analysis, maintenance, and problem detection), calibration and standards, calculation, and effect of storage. The method is termed tentative until it is adopted as standard.

23569

Wade, Marven A. and Stanley S. Yamamura

MICRODETERMINATION OF FLUORIDE USING AN IMPROVED DISTILLATION PROCEDURE. Anal. Chem., 37(10):1276-1278, Sept. 1965. 7 refs.

A versatile microdistillation procedure was developed for separating microgram levels of fluoride from anions and cations that interfere in colorimetric fluoride procedures. The distillation is carried out from a phosphoric acid medium with a microdistillation flask modified to minimize the carryover of phosphate and sulfate. The fluoride in the distillate is determinable by a number of colorimetric methods. In the study reported, the improved distillation-separation procedure was coupled with an Alizarin Complexone spectrophotometric measurement of fluoride. This resulted in a reliable method that appears to be suitable for a wide variety of samples. Of the 42 diverse ions tested (most of them at the 500 to 1 diverse ion-to-fluoride molar ratio), only borate and silicate interfered seriously. Based on 22 determinations at the 20-microgram fluoride level, the standard deviation of the combined distillation-spectrophotometric procedure is 3.0%.

23573

Wharton, H. Whitney

ISOLATION AND DETERMINATION OF MICROGRAM AMOUNTS OF FLUORIDE IN MATERIALS CONTAINING CALCIUM AND ORTHOPHOSPHATE. Anal. Chem., 34(10):1296-1298, Sept. 1962. 13 refs. (Presented at the American Chemical Society, Division of Analytical Chemistry, 141st Meeting, Washington, D. C., March 1962.)

Up to 4 micrograms of fluoride can be separated from dental enamel by gaseous diffusion of hydrogen fluoride from a perchloric acid solution of the sample in a polypropylene Conway diffusion dish. The HF is trapped in sodium hydroxide, while the resulting fluoride is determined spectrophotometrically by an improved zirconium- SPADNS (4,5-dihydroxy-3-(p-sulfophenylazo)-2,7-naphthalenedisulfoni acid, trisodium salt) bleaching method. Accuracy and reproducibility of the entire method are to plus or minus 0.05 microgram of fluoride at the 1 microgram level and plus or minus 0.07 microgram at the 3 microgram level. (Author abstract)

23575

Sieth, J.

REPORT ABOUT MEASUREMENTS OF WASTE GAS AT THE GRILLO DE- SULFURIZATION INSTALLATION AT UNION RHEINISCHE BRAUNKOHLEN- KRAFTSTOFF AG. FIRM IN WESSELING. Bericht uber Abgasmessungen an der Grillo-Entschwefelungsanlage bei der Firma Union Rheinische Braunkohlen-Kraftstoff AG. in Wesseling). Landesanstalt fuer Immissions-und Bodennutzungsschutz des Landes Nordhein-Westfalen, 46p., 1970. Translated from German. Belov and Associates, Denver, Colo., 31p., Sept. 9, 1970.

Research involving a stack gas cleaning operation for particulates, fluorine, and desulfurization is described. Sulfur trioxide and sulfur dioxide quantitites remaining in the treated gas are

measured. Treatment consists of dry alkaline additives, followed by cyclones and scrubbers. Stack samples are taken at four points; the methods and equipment are described. According to fluorine measurements, the optimum fluorine reduction is achieved in the desulfurization installation. No amounts of sulfur trioxide are detectable in the treated gas when the proper amount of desulfurizer is used.

23654

Brownley, Floyd I., Jr. and Charles W. Howle, Jr.

SPECTROPHOTOMETRIC DETERMINATION OF FLUORIDE IN WATER. Anal. Chem. 32(10):1330-1332, Sept. 1960. 8 refs.

A spectrophotometric method for the determination of fluorides in water is described which is based upon the colored complex formed between thorium and phenylfluorone. Experiments were designed to establish the optimum pH, optimum development time, and best ratio of color-producing reagents, and to ascertain the interferences from ions normally found in surface water. A pH of 3.6 was selected as best, since the absorbance was more nearly a linear function of the fluoride concentration at this pH. Color development appears to be almost instantaneous and absorbance is constant for at least an hour. However, necessary manipulation time for 10 or more samples would preclude the use of periods shorter than 25 min. A ratio of 2 ml of thorium nitrate solution to 2 ml of phenylfluorone solution was selected to produce a colored solution which would not be so optically dense as to be insensitive to small amounts of fluoride. When it became apparent that iron would interfere seriously, it was decided to eliminate completely all cations through the use of an ion exchange resin.

23657

Tufts, Barbara J.

A METHOD FOR IDENTIFYING PARTICULATE FLUORIDE COMPOUNDS. Anal. Chim. Acta, vol. 23:209-214, 1960. 13 refs. (Presented at the American Chemical Society, Air Pollution Symposium, Sept. 1959.)

A method is described for identifying particulates containing fluorides and other complex fluorine compounds such as fluosilicate in samples collected on membrane filters. The filter is treated with lead chloride to precipitate lead chlorofluoride at each fluoride-containing spot, and this microspot is identified by examination in a light microscope. Sulfate and phosphate, which also precipitate if present, can be distinguished and do not interfere. The fluoride precipitates are best seen as anisotropic white crystals in the optical microscope with crossed polars. They show polarization colors, which are especially distinctive in precipitates greater than 10 micron in diameter. Calibrations are given for the fluorides and the more insoluble salts, relating the original particle size to the reaction site size. Thus the mass of the particles can be calculated. Results of some field tests in an area of fluoride pollution are given, and compared with standard testing procedures. Samples containing hydrogen fluoride cannot be shipped or stored but must be reacted immediately after collection. (Author summary modified)

23683

Stanford Research Inst., Menlo Park, Calif.

ACTIVITIES OF THE NASA-SPONSORED SRI TECHNOLOGY APPLICATIONS TEAM IN TRANSFER OF AEROSPACE TECHNOLOGY TO THE PUBLIC SECTOR. Contract NASw-1992, NASA Rept. CR110238, SRI Quarterly Progress Rept. 2, 61p., 1970. CFSTI: N70 30531

In reporting a continuing program of aerospace technology transfer to the public sector, problems are reported in three principal categories; air pollution, criminalistics, and transportation. In the air pollution category, problem statements no. 10-16 are presented. These include the need for a rapid inspection technique to test compliance of motor vehicles with emission standards; a monitor for atmospheric fluorides; a method for disposal of waste wood; stabilization of mine and smelter waste piles; an instrument to measure atmospheric ozone; a monitor for atmospheric beryllium; and a sulfuric acid mist collector. The results of computer searches for relevant material for these and nine previously submitted air pollution problems are included. Reports of contact with user organizations include five reports of visits to west coast air pollution control organizations for the purpose of explaining the services offered and obtaining preliminary statement of problems. Two program problems are discussed, the variation among reference reviewers' opinions of the relevancy of specific references to a given problem, and the failure of the computer searches to find relevant references.

23767

Brown, Harry

A NEW INSTRUMENT FOR THE MEASUREMENT OF GASEOUS FLUORIDES TO LESS THAN ONE PART PER BILLION. Preprint, Leigh Instruments Ltd., Carleton Place (Ontario), 11p., 1969. (APCA Paper 69-119.)

An automated fluoride analyzer is described that will collect continuous air samples for a week and permit gaseous fluorides to be determined in the low ppb range, for which some states have already issued regulations. The method used by the instrument is an extension of the coated-tube method, where a tube coated with sodium carbonate collects the gaseous fluoride for subsequent detection by colorimetric analysis. A sodium carbonate solution is automatically pumped to one pipette and modified megregian colorimetric solutions to two other pipettes. After the pipettes are filled, a valve releases the sodium carbonate through the absorber tube and an air pump draws in air through a heated intake tube. Measurements are derived by washing the absorber tube with the colorimetric solution and then, to obtain a reading, comparing this tube with a duel cell photometer supplied with colorimetric solutions that have not been exposed to fluorides. Concentrations are measured in microgram F/cu m as a function of time, and two hour sampling periods are recommended for levels in the very low ppb range.

23907

West, Philip W.

ANALYTICAL METHODS FOR THE STUDY OF AIR POLLUTION. Pure Appl. Chem., 21(4):439-447, 1970. 21 refs.

A general discussion of the requirements of air pollution analytica techniques is presented, followed by descriptions of specific techniques for sulfur dioxide, nitrogen oxides, ozone, and hydrogen fluoride. Other inorganic gases and the category of organic gases are mentioned as being within the realm of air pollutants. The subject of particulate measurement is touched upon with some degree of emphasis on both organic and inorganic carcinogens. The applications of microscopy, mass spectroscopy, and several other instrumental techniques are briefly mentioned. The principal thesis is that a need exists for increasingly sensitive and specific methods of analysis for continuous monitoring, field test, and critical or definitive studies.

23947

Adams, Donald F.

A QUANTITATIVE STUDY OF THE LIMED FILTER PAPER TECHNIQUE FOR FLUORINE AIR POLLUTION STUDIES. Intern. J. Air Water Pollution (London), 4(3/4):247-255, 1961. 12 refs. (Presented at the American Chemical Society, 136th Meeting, Atlantic City, N. J., Sept. 1959.)

Some statistical relationships are presented between lime paper fluoride levels and experimental hydrogen fluoride atmospheric concentrations at constant air flow rates. The lime-impregnated papers were prepared by dipping Whatman No. 2, 11.0 cm filter paper in 10 g/liter of Fisher 'low in fluorine' lime. They were then dried to 50-60 C, hung in a phytotron plant growth chamber, and exposed to hydrogen fluoride in a chamber with a light source. At the end of each lime paper exposure period, the papers were removed from the fumigation chamber, dried for 24 hours at 70 C, weighed, ashed, distilled, and analyzed using a thorium nitrate titration. Correlation between the fluoride accumulated by the lime papers and the exposure indexes is quite high as indicated by the linear and curvilinear r values of 0.946 and 0.069. The data show an average fluoride collection rate of 7.6 micrograms F(-)/d sq m/day/micrograms F(-)/cu m. Results are discussed in relation to previously published literature relating fluoride accumulation in lime paper exposed to industrial air pollution under field and greenhouse conditions. Additional data are presented which show that the fluoride concentration in a greenhous atmosphere is significantly decreased over relatively short distances through processes of surface adsorption and foliar pickup (Author abstract modified)

24008

Nardozzi, M. J. and L. L. Lewis

PYROLYTIC SEPARATION AND DETERMINATION OF FLUORIDE IN RAW MATERIALS. Anal. Chem., 33(9):1261-1264, Aug. 1961. 11 refs.

Because fluoride separations from raw materials by distillation are difficult as well as lengthy, another separation technique was evaluated which consists of passing moist oxygen over the sample in a heated tube, sweeping the fluoride released through the tube, and collecting the fluoride in a suitable medium for determination. A quartz combustion tube is employed and heated to 1000 C. The sampl is mixed with tungstic oxide as a reaction accelerator, while oxygen is passed through the system at a rate of about 1200 ml per min. When the samples contain less than 0.1% fluoride or also contain acidic substances, then the slower spectrophotometric method must be used in place of titration. Thorium chloranilate is a very useful reagent for the spectrophotometric determination of fluoride because acetate, sulfate, sulfite, nitrate, nitrite, chloride, bromide, iodide, and thiosulfate ions do not interfere, and phosphate and molybdate interfere only when present in amounts equal to or in excess of the fluoride concentrations. To overcome the interference of iron and aluminum in samples of slag, the samples should be treated prior to pyrolysis to cause hydrolysis or the fluoride should be determined titrimetrically. However, errors arise when sulfur is present in titrimetric determinations.

24018

Harris, W. E.

AMPEROMETRIC TITRATION OF FLUORIDE WITH THORIUM USING A ROTATING PALLADIUM ELECTRODE. Anal. Chem., 30(5):1000-1003, May 1958. 14 refs.

The amperometric titration method for determining traces of fluoride is performed in a solution containing potassium bromide, potassium sulfate, and aerosol, and buffered with monochloroacetic acid and sodium monochloroacetate. Best results are obtained with about 100 to 200 gamma of fluoride per 100 ml of solution, although as little as 20 gamma in 100 ml can be determined. Moderate amounts of chloride, nitrate, sulfate, perchlorate, borate, calcium, or magnesium cause no interference but large amounts slightly decrease the sensitivity. Aluminum and more than 1 mg/l of phosphate interfere. Reagents, apparatus, and the recommended procedure are indicated. (Author abstract)

24022

Crocket, David S. and Robert A. Grossman

INTERACTION OF AMMONIUM FLUORIDE MULLS AND DEPOSITED FILMS WITH SODIUM CHLORIDE PLATES. Anal. Chem., 34(11):1505-1506, Oct. 1962. 7 refs.

Anomalous absorption peaks were found when ammonium fluoride was run as a mull, as well as when it was deposited as a film from anhydrous methanol. All spectra were run using a Beckman I-R5 spectrophotometer, while the x-ray powder photograph of the surface scrapings from sodium chloride plates was taken using CuK-alpha radiation. The ammonium fluoride run, both as a mull and as a film deposited from methanol, gives only a spectrum comparable to ammonium chloride. In order to get any indication at all of the presence of ammonium fluoride, it was necessary either to precipitate the ammonium fluoride from anhydrous methanol solution with dry ether, or to dry the ammonium fluoride for extended periods of time at a temperature just below the sublimation temperature, and then to prepare the mulls in a dry box.

24050

Sarma, P. L.

SPECTROPHOTOMETRIC DETERMINATION OF FLUORIDE BY ZIRCONIUM- ERIOCHROME CYANINE R. Anal. Chem., 36(8):1684-1685, July 1964. 11 refs.

The fluoride concentration range which is most suitable for spectrophotometric determination using original and modified Megregian zirconium-Eriochrome Cyanine R reagents was determined. A standard solution containing 100 ppm of fluoride was prepared by dissolving 0.2221 gram of 99.5% pure sodium fluoride in water and diluting it to 1 liter, while other standard solutions were prepared by diluting aliquots of this solution ot proper volumes. Per cent transmittance readings of reagent A (Eriochrome Cyanine R) and reagent B (Zirconium Chloride) were obtained at 528 millimicrons, maintaining the temperature within 25 plus or minus 1 C. Considering both the minimum relative concentration error and the linear absorbance-concentration range, Megregian's original reagent appears suitable for use in the determination of about 1.0 to 1.4 ppm of fluoride. However, from the same considerations, a modified reagent containing 1 volume of reagent A and 2 volumes of reagent B will be suitable for determining about 2.0 to 3.0 ppm.

24114

Fox, E. J. and W. A. Jackson

STEAM DISTILLATION OF FLUORINE FROM PERCHLORIC ACID SOLUTIONS OF ALUMINIFEROUS ORES. Anal. Chem., 31(10):1657-1662, Oct. 1959. 25 refs.

An all-glass multiple-unit fluorine distilling apparatus equipped with automatic temperature controls was developed in a study of factors affecting the volatilization of fluorine during the

acidulation of phosphate rock. An improved apparatus and the analytical procedure are discussed. Sodium and calcium fluorides, or even the slightly more complex calcium fluosilicate dihydrate, show little difference in the rate of fluorine distillation from perchloric acid at 125 C. A rate of about 15% per minute for each of these salts is indicated by the slope of the main branches of the curves. While phosphate rock may not be regarded as a simple compound, the fluorine in the rock, for the most part, behaves as calcium fluosilicate while a relatively small proporation of it behaves like fluorine in Pembroke clay. The initial rate for the first and second fluoride ions of aluminum fluoride trihydrate is about one third the rate for fluorine in sodium fluoride, or approximately 5% per minute. Results obtained with this equipment indicate that the interference of aluminum in the steam distillatio of fluorine from perchloric acid solutions of aluminum-bearing rocks is caused by the formation of acid-soluble complex ions of aluminum, fluorine, and oossibly other elements that greatly reduce the partial pressure of fluorine compounds in the gas phase above the distilling acid solution. A procedure for simultaneous double distillation to speed up the operation is described. (Autho abstract modified)

24118

McCabe, Louis C.

ATMOSPHERIC POLLUTION. Ind. Eng. Chem., 45(8):105A-108A, Aug. 1953. 6 refs.

Various filter media were evaluated with respect to certain air sampling requirements by the dioctyl pthalate smoke penetration meter. Several properties and applications are presented tabularly for chemical filter papers, membrane filters, feltlike and mineral fiber papers, and all-glass papers. At the same meeting of the American Society for Testing Materials (July 1953), another paper described some instrumentation and analytical techniques which had proved useful in the study of air pollution with particular reference to the Windsor-Detroit area. A continuous recording analyzer for trace quantities of hydrogen fluoride in the atmosphere is based on a test in which a metal oxinate fluoresces under ultraviolet light, and the fluorescence is quenched by exposure to hydrogen fluoride. In order to study the relationship between smog occurrence and oxidant concentration, a continuous recorder was constructed which produces a record in terms of ozone equivalents. The oxidant recorder consists essentially of a countercurrent absorption tower of glass beads as the air-liquid contacting device. Air containing ozone, nitrogen oxides, or other oxidants liberates iodine from a buffered, neutral potassium iodide solution. The light transmission of the resulting yellow solution is measured by a double-cell colorimeter at 3600 A.

24124

Powell, W. Allan and J. H. Saylor

FLUOROMETRIC DETERMINATION OF SMALL AMOUNTS OF FLUORIDE. Anal. Chem., 25(6):960-964, June 1953. 15 refs.

Methods are described for the fluorometric determination of traces of fluoride with a precision equal to or better than previous methods and which are less subject to anion interference. Experimental equipment comprised a Lumetron fluorometer and a Beckman pH meter. A Corning 5860 primary filter was used for the isolation of the desired excitation band and a Corning 3389 secondary filter for the fluorescence band. Most of the methods previously described for the fluorometric detection or determinatio of aluminum were studied: those using morin, quercetin, 8-quinolinol, Eriochrome Blue Black B, which is an isomer of Pontachrome Blue Black R, and Eriochrome Red B. Superchrome Garnet Y was also studied. The methods finally developed depend upon the fact that the intensity of fluorescence of the compounds formed on reaction of aluminum chloride with the dihydroxyazo dyes, Eriochrom Red B and Superchrome Garnet Y, is decreased on addition of fluoride. Plots of intensity of fluorescence versus pH show a maximum at pH 4.8, while the intensity decreases slightly with increase in the buffer concentration. Effects of concentration and purity of dyes were also determined. The intensity of fluorescence increases linearly with increase in concentration of ethyl alcohol and decrease in temperature. The methods were tested by analyzing solutions of pure sodium fluoride both before and after a Willard- Winter distillation.

24222

Her Majesty's Factory Inspectorate. (Great Britain) Dept. of Employment and Productivity

METHODS FOR THE DETECTION OF TOXIC SUBSTANCES IN AIR. HYDROGEN FLUORIDE AND OTHER INORGANIC FLUORIDES. Booklet 19, 15p., 1970. 5 refs.

Apparatus, procedures, reagents, and where applicable, interferences are given for two tests for determining fluoride concentrations in factory atmospheres. The primary object is not to obtain an extreme degree of accuracy but to give a rapid indication of whether or not the atmosphere is dangerous, as determined by comparison with government-established threshold limit and ceiling values. The occurrence and toxic effects of fluorides are briefly described. The first method described is a field test in which hydrogen fluoride is collected in an acid solution of zirconium-solochrome cyanine R complex and the observed bleaching in color is compared with glass color standards. The second is a simple laboratory method to determine total inorganic fluoride in air, in which hydrogen fluoride and fluoride-containing dust and fume are collected on an alkali- impregnated paper which is placed in a micro diffusion vessel. Acid is added and the released hydrogen fluoride is trapped by an alkaline coating on the inside lid of the vessel. The alkali is quantitatively transferred to a volumetric flask, lanthanum- alizarin fluorine blue reagent added and the fluoride determined either spectrophotometrically or visually by comparison with a set of glass color standards.

24279

Adams, Donald F., Robert K. Koppe, and Norman E. Matzek

COLORIMETRIC METHOD FOR CONTINUOUS RECORDING ANALYSIS OF ATMOSPHERIC FLUORIDE. TEST CHAMBER AND INTERFERENCE STUDIES WITH THE MINI-ADAK ANALYZER. Anal. Chem., 33(1):117-119, Jan. 1961. 19 refs. (Presented at Meeting of the American Chemical Society, 138th, Division of Water and Waste Chemistry, New York, Sept. 1960.)

The tolerance of a low fluoride (micrograms/cu m or ppb atmospheric concentration range) reagent to other pollutants is delimited; the reagent is incorporated in a recently reported automatic continuous measurement and recording method using the Mini-Adak Analyzer for atmospheric fluorides. The reagent consists of a zirconium-Eriochrome Cyanine R complex. Statistical comparison was made between the continuous Mini-Adak record and manual air sampling and analysis data of controlled test chamber atmospheres. Instrumental analysis of chamber atmospheres revealed a fine structure of changing diurnal concentrations not previously possible with the long-term averaging-type sampling. The minimum sensitivity of the fluoride reagent is stated as any combination of micrograms of

F per cu and minutes of exposure time, yielding a value of 30. Recent improvements in the photometric circuitry have reduced the sensitivity factor to 7.5. Los Angeles smog-type gases appear to be compatible with the reagent. The reagent may be subject to interference from phosphate, sulfate, and aluminum. However, phosphate appears to offer the only significant source of error under typical field sampling conditions. The Mini-Adak analyzer with the low fluoride reagent has an approximate 18% analysis efficiency for submicron cryolite.

24310

Senkowski, B. Z., E. G. Wollish, and E. G. E. Shafer

RAPID DETERMINATION OF ORGANICALLY BOUND FLUORINE. Anal. Chem., 31(9):1574-1576, Sept. 1959. 11 refs.

A rapid and simple procedure is described for the determination of organically bound fluorine. In a Schoeniger borosilicate glass flask, the sample is burned in the presence of a small quantity of sodium peroxide. This is directly followed by colorimetry using zirconyl-Eriochrome Cyanine R complex; absorbance is determined photometrically by Megregian's procedure. Small quantities of phosphates do not interfere, but larger proportions require a Willard-Winter distillation. Less than 1 hour per determination is required, unlike previous methods which required a separation procedure following decomposition of the sample. The experimental procedure is described in detail. (Author abstract modified)

24315

NEW FLUORIDE RECORDER. Res. Ind. (Stanford Res. Inst.), 11(3): 10, May 1959.

A recorder is mentioned which measures concentrations of fluorides as low as one or two parts per ten billion. It works on the principle of a differential photometer--that is, photoelectric cells measure the difference in reactions on adjacent areas of a fluorescent tape. One of these areas is reacted on by a air sample containing hydrogen fluoride, and the other by a sample from which the hydrogen fluoride has been removed.

24331

Bartlett, John C., Doris Kavanagh, and Ross A. Chapman

THE DETERMINATION OF THE FLUORIDE CONTENT OF EDIBLE BONE MEAL. Can. J. Chem. Eng., vol. 33:348-355, 1955. 17 refs.

Fluoride is determined in edible bone meal by igniting a sample at a temperature between 550 and 750 C. A Willard and Winter distillation from perchloric acid is used to separate fluoride from interferences, and the amount of fluoride in the distillate is measured by the amount of bleaching of a ferric salicylate solution at a pH of 3.1. The optimum conditions of acidity and reagent concentration were investigated and the effects of interfering substances were determined. An optimum weight ratio of ferric iron and salicylic acid is 0.404, which corresponds to 1.00 on a molar basis. Calibration and details of the procedure are discussed; the standard error of the method as applied to bone meal is plus or minus 2.3%. (Author abstract modified)

24359

Deutsch, Samuel

OVERCOMING THE EFFECT OF MANGANESE DIOXIDE IN FLUORIDE DETERMINATIONS. Anal. Chem., 27(7):1154-1155, July 1955. 3 refs.

Both manganese dioxide and chlorides in vegetation samples interfere with the modified Willard-Winter method for the microdetermination of fluoride. Liberation of chlorine during distillation hampers the titration of fluorides by a partial or complete bleaching of the alizarin red indicator. The addition of 3% hydrogen peroxide in the fluoride distillation flask before the start of distillation eliminates this interference. Tests of the reproducibility of fluoride recovery in the presence of 3% hydrogen perioxide as a reductant showed that addition of 3% hydrogen peroxide did not interfere with fluoride recovery or subsequent titration. (Author abstract)

24372

ANALYSIS OF HF GAS. Instr. Automation, vol. 27:350-353, March 1954.

A new method of detecting and continuously measuring ppb quantities of hydrogen fluoride gas, a potentially injurious air pollutant, entails impregnating a roll of filter paper with a fluorescent metal salt. Contact with the slight trace of HF gas diminishes the fluorescence, which is measured photoelectrically. Results are graphed on a continuous recorder.

24399

Adams, Donald F., Robert K. Koppe, and Homer J. Dana

AN AUTOMATIC ATMOSPHERIC FLUORIDE ANALYZER WITH POTENTIAL APPLICATIONS TO OTHER POLLUTANTS. J. Air Pollution Control Assoc., 9(3):160-168, Nov. 1959. 23 refs.

Two separate prototype analyzer units were constructed and assemble within a single metal enclosure to permit convenient, simultaneous development and field testing of reagents for the determination of sulfur dioxide and hydrogen fluoride in the atmosphere. Each versatile analyzer consists of two fundamental components: a colorimeter capable of either triggering a time stamp upon development of a pre-selected photocell output equivalent to some concentration of the pollutant which has been absorbed in the reagent (dosimeter model) or driving a recorder (the continuous recording model); and an air-reagent contacting system in which a continuously circulating volume of reagent contacts a sampled air stream until a preselected concentration of the desired pollutant has been absorbed by the reagent. Fluoride reagent is prepared by adding 200 ml of acidified zirconium solution to 500 ml of of distilled water, followed by 200 ml of a dye solution. Then 3.00 g Surfynol 82 are added, and the mixture is diluted to 1 liter Two drops of Dow-Corning Anti-foam A Emulsion are then added. Successful field and laboratory tests have been carried out with this analyzer and fluoride reagent.

24456

Yamamura, S. S., M. A. Wade, and J. H. Sikes

DIRECT SPECTROPHOTOMETRIC FLUORIDE DETERMINATION. Anal. Chem., 34(10):1308-1312, Sept. 1962. 11 refs. (Presented at the American Chemical Society, Division of Analytical Chemistry, 141st Meeting, Washington, D. C., March 1962.)

Fluoride reacts with the wine-red cerium(III)-alizarin complexone (1,2-dihydroxyanthraquinon-3-ylmethylamine-N,N-diacetic acid) complex to produce a lilac-blue color. As the basis for a colorimetric method for microgram levels of fluoride, two ratios of cerium(III) to alizarin complexone are used. A 1:1 mole ratio gives high tolerance for common anions that do not complex cerium (III) as well as for many cations. A 1:2.5 ratio gives increased tolerance for complexing anions such as sulfate and phosphate. These effects are explained by a con-

sideration of various equilibri involved. Use of a 20% acetonitrile or acetone medium rather than water alone increases both the sensitivity of the reaction and the stability of the complexes. The sensitivity, with a 1:1 mole ratio reagent in the acetonitrile medium, is .0014 microgram of fluoride per sq cm. Data are presented showing the usefulness of the method for the direct determination of fluoride in natural waters and for the analysis of complex inorganic samples following a pyrolysis separation. (Author abstract)

24546

Yamamura, Stanley S., Maxine Elliott Kussy, and James E. Rein

COMPLEXOMETRIC DETERMINATION OF FLUORIDE WITH CERIUM(III). Anal. Chem., 33(12):1655-1657, Nov. 1961. 6 refs. (Presented at the Analytical Chemistry Conference in Nuclear Reactor Technology, 4th, Gatlinburg, Tenn., Oct. 12-14, 1960.)

A method is presented, involving a pyrolysis separation and a cerium precipitation-EDTA titration measurement, which is applicable to a variety of samples containing fluoride complexing metals such as zirconium, uranium, aluminum, and beryllium, and high concentrations of nitrate and chloride. Quantitative recovery of 5 to 40 mg portions of fluoride was obtained by pyrolyzing at 950 C for 10 min using a moist air flow of 2.5 liters/min. Addition of aluminum nitrate to the sample controls the release of fluoride from volatile samples and also serves as an accelerator for others. Cerous fluoride is precipitated stoichiometrically at pH 1.75 with a measured excess of cerium(III), and the excess cerium is back-titrated with EDTA ((ethylenedinitrilo)tetraacetic acid) to an arseneazo-cresol red end point. Sulfate and phosphate interfere seriously in the precipitation. The computed standard deviation for a single determination based on 6 replicate determinations at the 24 and 36 mg levels of fluoride was 0.42 mg.

24603

Greenburg, Leonard and Morris B. Jacobs

AIR POLLUTION CONTROL: HEALTH ASPECTS AND MICROTECHNIQUES. Trans. N. Y. Acad. Sci., Ser. 2, 18(4):289-297, Feb. 1956. 28 refs.

The greatest source of air pollution in New York City is burning fuels. The relationship of air pollution to health is dramatically indicated by the episodes in the Meuse Valley, in Donora, Pa., in Poza Rica, Mexico, and in London, England. The principal category of microanalysis in air pollution studies is the determination of very small amounts of a substance in a large volume of air. The principle of deposition is used for sootfall or dustfall sampling. Absorption methods for air sampling are of two types: impingers an absorbers. Filtration methods include the high-volume sampler, the automatic paper tape samplers, and millipore filters. Condensation and adsorption are also employed in collecting work. The peroxide method is preferred over the alkaline iodide or colorimetric method in analyzing sulfur dioxide. Sulfur trioxide can be measure by direct titration and gravimetrically. Infrared spectrometry is the method of choice for determining carbon monoxide; however, the CO tube colorimetry method has been adopted by some investigators. The method commonly used for nitrogen oxides involves estimating by the phenodisulfonic acid method. Ammonia and ammonia compounds are trapped in a bubbler containing sulfuric acid and are estimating by nesslerization. Methods of analysis are described for aldehydes, cyanides, fluorides, ozone, hydrogen sulfide, lead, hydrocarbons, and other components.

24886

McCarty, Charles P. and Elmer Robinson

EFFECT OF COLD STORAGE ON THE FLUORIDE CONTENT OF ALFALFA. J. Agri. Food Chem., 5(5):377-379, May 1957. 4 refs.

The tediousness of determinations of fluoride in vegetation samples, coupled with a frequent need to gather a large number of samples in a short time, usually requires storage of samples prior to analysis. Tests using alfalfa samples were conducted to determine the effect of storage at O F for four to six weeks on fluoride content. Stored samples showed more variation than unstored samples but no consistent change in fluoride content. The variation can be reduced by adding lime to stored samples. Samples stored in a tight container do not gain or lose moisture consistently. (Author abstract)

24966

Thomas, M. D. and R. E. Amtower

THE MICRODETERMINATION OF FLUORIDE IN VEGETATION. Air Follution Control Assoc. J., 19(6):439-442, June 1969. 16 refs.

The determination of fluorine in vegetation is generally carried out by a modification of the Willard-Winter method. This method gives satisfactory results, but it is rather laborious and time- consuming and requires considerable equipment. For microchemical work on very small vegetation samples or fractions such as chloroplasts, in which the total fluorine available is usually of the order of a few micrograms, other techniques are required. A micro method for the determination of the fluoride content of plant materials, particularly the leaves, is described. The samples are dried and ground to a fine powder. Fifty mg samples are burned in oxygen in 250-ml separatory funnels or in 300-ml Erlenmeyer flasks. The gaseous products of the combustion are absorbed in 0.1N sodium hydroxide in the closed funnel or flask and transferred to a small covered plastic dish in which the fluoride is diffused to tiny droplets of 3N sodium hydroxide solution distributed over the lower side of a tight fitting cover. The diffused fluoride is dissolved in water and determined colorimetrically by the SPADNS reagent. The sensitivity of the method is directly proportional to that of the SPADNS dye used to measure the fluoride.

24970

Heilingoetter, R.

ANALYTICAL METHODS USED TO DETERMINE DAMAGE BY ACIDS IN THE ATMOSPHERE. (Die chemische Untersuchungsmethoden des Luftsaeureschaedenexperten). Text in German. Chemiker-Zeitung, 51(45):429-433, June 8, 1927.

The three methods available for the assessment of damage caused by atmospheric acids are the so called leaf and needle ash analysis which directly measures damage caused to plants, atmospheric acid analysis by which the harmful content of acids can be measured on the spot and the qualitative determination of small quantities of acid in the atmosphere. The first method is based on the accumulation of acid in the exposed plants. In the ash of such exposed plant material (needles of conifers for example) water- soluble sulfuric acid, chlorine, fluorine, and nitrogen are determined and the excess over normal levels is calculated. The second method, analyzing air acidity directly, uses a series of absorption bottles filled with different absorbent liquids designed to retain carbon dioxide, sulfur dioxide, sulfur trioxide, nitrogen oxides, ammonia, chlorides and hydrochloric acid which are then measured by appropriate analytical methods and the respective acidity is calculated. Toxicity limits are for SO2 3 mg/cu m, for N2O4 50 mg/cu m, for NH3 30 mg/cu m, for HCl 110 mg/cu m, for

Cl2 64 mg/cu m and for HF 0.00033 vol %. The qualitative method uses cotton cloth dipped in a barium hydroxide solution and in lime water to determine the presence in the atmosphere of SO2 and of F respectively.

25180

Mandl, Richard H., Leonard H. Weinstein, Gilbert J. Weiskopf, and Judy L. Major

THE SEPARATION AND COLLECTION OF GASEOUS AND PARTICULATE FLUORIDES. Preprint, International Union of Air Pollution Prevention Associations, 37p., 1970. 19 refs. (Presented at the Internationa Clean Air Congress, 2nd, Washington, D. C., Dec. 6-11, 1970, Paper CP-25A.)

The separation of gaseous from particulate fluorides in ambient air is essential for the enforcement of air quality standards by governmental agencies and may also be important in monitoring experimental fumigations under laboratory of field conditions. Two methods were selected for extensive study. The bicarbonate- coated tube coupled with a membrane filter for collection of particulate fluoride proved successful. The most useful combinatio was a 7-mm I.D. by 122 cm Pyrex glass tube with an Acropore AN-800 filter and a sampling rate of 14.1 liters per minute (0.5 cfm). An automatic paper tape sampler was developed also in which the air sampler is drawn first through a citric acid-treated Whatman No. 52 prefilter to remove particulate fluorides and then through a sodium hydroxide-treated Whatman No. 4 paper for collection of gaseous fluoride. Both methods have been tested in the laboratory and in field plot experiments. (Author abstract modified)

25210

Jacobson, Jay S. and Laurence I. Heller

SELECTIVE ION ELECTRODE ANALYSIS OF FLUORIDE IN VEGETATION. Preprint, International Union of Air Pollution Prevention Associations, 17p., 1970. 38 refs. (Presented at the International Clean Air Congress, 2nd, Washington, D. C., Dec. 6-11, 1970, Paper CP-25B.)

Many laboratories carry out fluoride analyses of vegetation to determine the sources, distribution, and effects of atmospheric fluorides. The techniques and procedures used vary widely from laboratory to laboratory, but all are laborious and provide many sources of error. The fluoride ion electrode offers the possibilit of circumventing conventional ashing, fusion, and distillation techniques. Therefore, methods of extracting vegetation and performing potentiometric analyses were evaluated. A procedure was developed which employs sequential extraction of dried, pulverized vegetation with 0.05 N sulfuric acid followed by 0.05 N ammonium hydroxide. After neutralization, pH 7 acetate buffer and sodium citrate are added to the slurry to control pH and ionic strength and to mask potential interfering agents. Analyses were performed with continuous stirring on the suspension of vegetation with an Orion combination fluoride-reference electrode and an appropriate electrometer. Standard fluoride solutions containing all reagents were also analyzed to provide a calibration curve from 0.05 to 10.0 ppm w/v fluoride. In this manner, vegetation samples containing 20 to 2000 ppm w/w fluoride could be analyzed. The accuracy of the extraction-potentiometric method was verified by several techniques. The amount of fluoride found by analysis was directly related to amount of sample taken, and recovery of known amounts of added fluoride was better than 95%. A correlation coefficient of 0.9994 was obtained when measurements by this method were compared with those by conventional methods. The relative standard deviation of replicate analyses in the 20-370 ppm range was 5.7%. However, the absolute accuracy of the method is not known because primary standards are not available. Collaborative studies are planned to determine whether this rapid and simple technique can be recommended as a suitable substitute for conventional techniques. (Author abstract modified)

25223

Liberti, Arnaldo and Marco Mascini

CONTINUOUS MEASUREMENTS OF ATMOSPHERIC POLLUTANTS BY MEANS OF SPECIFIC ION MEMBRANE ELECTRODES. Preprint, International Union of Air Pollution Prevention Associations, 23p., 1970. 3 refs. (Presented at the International Clean Air Congress, 2nd, Washington D. C., Dec. 6-11, 1970, Paper CP-31G.)

Information is presented which is directed to the utilization of specific ion membrane electrodes to measure atmospheric pollutants. As these electrodes measure the activity of an ion in solution, they can be used either to follow the variation of concentration of an ion which is directly absorbed from the air or of an ion of a solution reacting with a certain pollutant. Various experimental devices are presented to perform either a continuous or an intermittent determination by a direct measurement or by a coulometric titration. Typical examples are the continuous measurement of fluoride in stack gases and the ozone and total oxidants determination in the air. The use of a fluoride selective electrode permits continuous recording of the fluoride content of stacks; gases are adsorbed into a cell containing a buffered solution where a fluoride selective membrane electrode and a saturated calomel electrode are set. The potential difference is continuously measured. Lower fluoride concentration may be determined by passing the adsorbing solution into a titration cell. The neutral potassium iodide procedure for total oxidants determination can be carried out electrometrically with various apparatus. Air is drawn into a cell where an iodide membrane electrode records the iodide concentration; other examples of analyses where membrane electrodes may be used include the monitoring of sulfur dioxide, hydrogen sulfide, and hydrogen cyanide. (Author abstract)

25441

Miller, Gene W., Ming-Ho Yu, and Esther Chen

GAS CHROMATOGRAPHIC ANALYSIS OF FLUOROORGANIC ACIDS IN PLANT AND ANIMAL TISSUES. Preprint, International Union of Air Pollution Prevention Associations, 12p., 1970. 15 refs. (Presented at the International Clean Air Congress, 2nd, Washington, D. C., Dec. 6-11, 1970, Paper MB-4E.)

Studies were initiated to develop gas chromatographic techniques for determining fluoroorganic acids in tissues, but the extraction and methylation procedures separated only ether soluble methyl esters of organic acids. To date, the presence of both fluoroacetic and fluorocitric acids has been tentatively identified in both plant and animal tissues.

25474

Prinz, Bernd

THE APPLICATION OF STATISTICAL METHODS TO SAMPLING DESIGN IN THE PLANNING OF AIR-QUALITY MEASURING PROJECTS. Staub (English translation from German of: Staub, Reinhaltung Luft), 30(5):23-31, May 1970. 15 refs.

For purposes of air quality measurements, the applicability of two methods of sampling design were investigated: the method of the stratified sample and the method of the regression esti-

mate. The concept of parent population denotes the maximum possible number of observations which pertain to one definite property or to a group of properties and which can be distinguished by some kind of description or definition from other correlated observations. Applying the method of the stratified sample to air quality measurement projects, one has to proceed by first dividing into strata the parent population of all measurements of a given area and in a given time interval, in such a way that within the individual strata the quantities observed are as homogeneous as possible, with the mean values between the strata differing as much as possible. A fluorine measurement program is used to illustrate this method. Often, a certain sample variable cannot be determined and its mean value calculated, except with considerable experimenta expenditure, while an auxiliary variable which shows a high correlation to the sample variable proper can be investigated without difficulty. Frequently, it is inconvenient or impossible to encompass the parent population of an auxiliary variable in orde to derive its mean value. Nevertheless, it may be useful to introduce an auxiliary variable, to investigate it using a large sample size and, by means of the regression estimate, to infer from its own mean value on the mean value of the main variable having a smaller sample size.

25487

Pack, M. R., A. C. Hill, and H. M. Benedict

SAMPLING ATMOSPHERIC FLUORIDES WITH GLASS FIBER FILTERS. J. Air Pollution Control Assoc., 13(8):374-377, Aug. 1963. 8 refs.

The use of glass fiber filters for collecting atmospheric fluorides and separating particulate and gaseous fractions was investigated. Because of their low fluoride blanks, MSA type 1106-B filters were selected for study. These filters are placed in open-faced metal holders coated with polyvinyl plastic and air is drawn through them with a rotary, pressure-vacuum, vane-type pump. A second filter used as backing between the filter and filter support reduces the possibility of sample contamination by the holder. The fluoride is isolated from the sampling filter by distillation from perchloric acid: no ashing or fusion is necessary unless the fluoride being determined is very nonreactive. If less than 30 micrograms of fluoride are anticipated, the fluoride is concentrated from the
the anion exchange resin method and measure spectrophotometrically. Larger amounts are titrated with thorium nitrate; alizarin is used as indicator. The glass fiber filters were compared with impingers in tests conducted in three different types of atmospheres: (1) in a controlled atmosphere with hydrogen fluoride; (2) on an industrial plant property where both gaseous an particulate fluorides were present; and (3) in an urban residential commercial district. There was no statistically significant difference between the average fluoride concentrations obtained by the two sampling methods. Of the separation method studied, the most effective was the use of an aluminum tube apparatus preceding the glass fiber filters. When both this apparatus and an impinger were placed in an atmosphere where about 70% of the fluoride was in particulate form, the average measured particulate concentrations f each method were almost identical. The results indicate that the filters offer a reliable, simple, and convenient method of collecti total atmospheric fluorides at a minimum cost for equipment and maintenance.

25615

McKenna, F. E.

METHODS OF FLUORINE AND FLUORIDE ANALYSIS - I. Nucleonics, 8(6): 24-33, June 1951. 146 refs. Part II. Ibid., 9(1):40-49, July 1951. 153 refs. Part III. Ibid., 9(2):51-58, Aug. 1951. 217 refs.

A review of the literature on methods of analysis for fluorine compounds is presented, covering the period from 1816 to 1950. This first of three parts discusses the following methods: determination as lead chlorofluoride, as calcium fluoride, by reaction with aluminum, by reaction with iron (III), as lanthanum fluoride, as yttrium flouride, as cerium (III) fluoride, and by formation of thorium fluoride. The discussion of the latter is completed in Part II.

25616

McKenna, F. E.

METHODS OF FLUORINE AND FLUORIDE ANALYSIS - II. Nucleonics, 9(1):40-49, July 1951. 153 refs. Part I. Ibid., 8(6):24-33, June 1951. 146 refs. Part III. Ibid., 9(2):51-58, Aug. 1951. 217 refs.

A review of the literature on methods of analysis for fluorine compounds is presented, covering the period from 1816 to 1950. This second of three parts discusses the following methods: determination by formation of thorium fluoride (continued from Part I), by zirconium fluoride, lakes of zirconium, and by fluosilic acid. The isolation of fluoride as the volatile fluosilicic acid is also considered at length, including alkimetric titration of fluosilicic acid.

25617

McKenna, F. E.

METHODS OF FLUORINE AND FLUORIDE ANALYSIS - III. Nucleonics, 9(2):51-58, Aug. 1951. 217 refs. Part I. Ibid., 8(6):24-33, June 1951. 146 refs. Part II. Ibid., 9(1):40-49, July 1951. 153 refs.

A review of the literature on methods of analysis for fluorine compounds is presented, covering the period from 1816 to 1950. This last of three parts discusses the pertitanic acid and fluosilicic acid methods as well as analysis of fluorocarbons, volatile fluorides, and elementary fluorine. Spectrochemical and miscellaneous analytical methods are treated briefly. References are given for determination of fluorides in specific substances, inc as aerosols, beryllium compounds, foods, strial materials, soils, and human tissues.

25631

FLUORIDE FOILERS. Chem. Eng. News, vol. 34:1506, 1509, March 26, 1956.

It is now standard procedure for any plant facing a potential fluoride effluent problem to main constant checks on vegetation and animals in its vicinity, not only to monitor the effluent control system but also to have a continuing factual record available if complaints are received. To permit plant chemists to check on the accuracy of their analytical techniques without running replicate analyses, a series of 35 standarized fluoride samples has been developed. They are derived from a broad range of minerals, vegetation, and animal tissue commonly found in industrial fluoride problems--soils, ores, slags, dusts, fertilizers, feeds, hays, pine needles, tree barks, etc. Samples, which cost $13 each, are available with fluoride concentrations of from 5 to 1500 ppm.

25647

Adams, Donald F.

AN AUTOMATIC HYDROGEN FLUORIDE RECORDER PROPOSED FOR INDUSTRIAL HYGIENE AND STACK

MONITORING. Anal. Chem., 32(10):1312-1316, Sept. 1960. 12 refs. (Presented at the American Chemical Society, Division of Water Sewage, and Sanitation, 136th Meeting, Atlantic City, N. J., Sept. 1959.)

The increasing use of fluorine and fluorides in industrial processes requires the close surveillance of the fluoride content of the air in working areas and adjacent environs. Conventional sampling and analytical techniques are time consuming and not suitable for an alarm system to warn personnel of the presence of objectionable exposure levels. A method is needed for continuously and instantaneously recording changes in the fluoride content of both indoor and outdoor air. Fluoride levels from 0.1 to 200 mg per cu m are determined by measuring the color change produced by the reaction between the green iron-ferron (8-hydroxy-7-iodo-5- quinoline-sulfonic acid) complex and fluoride ions. A method of automating this technique is suggested. (Author abstract modified)

25668

SPECTROPHOTOMETRIC DETERMINATION OF FLUORIDE ION. In: Manual of Standard Procedures. Atomic Energy Commission, New York, Health and Safety Lab., Rept., TID-4500, 5p., Sept. 1970. 1 ref. NTIS: NYO-4700(3rd Ed.)

In the method described, the determination of fluoride ion depends upon fluoride quenching of the thorium-chrome Azurol S lake. Fluoride ion in the range of 0.1 to 90 microgram may be determined in sodium hydroxide solutions used in air sampling, and in air filters, water, or urine samples. A spectrophotometer and distillation apparatus, as diagrammed, are required. Data are given on special reagents, sample preparation, and determination procedure. Ions such as sulfate, phosphate, uranium (VI), iron (III), aluminym, and beryllium interfere but can be removed by the distillation procedure. Only chloride interferes before and after distillation of fluorine.

25806

Cholak, J.

CURRENT INFORMATION ON THE QUANTITIES OF FLUORIDE FOUND IN AIR, FOOD, AND WATER. A.M.A. Arch. Ind. Health, 21(4):312-315, April 1960.

The significance of the result of a determination of fluoride in the investigation of the behavior of the fluoride ion in biological material depends partly upon the techniques and precautions employed in collecting the sample and partly upon the precision of the analytical procedure that is employed. The general analytical technique involves three procedures: the conversion of the fluoride into soluble, inorganic form by means of an ashing step usually carried out at 600 C; the separation of fluoride as hydrofluosilicic acid from interfering ions by the Willard and Winter distillation procedure, and the estimation of the quantity of fluoride in the distillate. This estimation may be done by determining the bleaching effect of the fluoride ion on colored metal dye complexes by a titration procedures. Further details of fluoride determinations are described, and concentrations are presented tabularly for fluorides in air, food, and water.

25816

Adams, Donald F.

FURTHER APPLICATIONS OF THE LIMED FILTER PAPER TECHNIQUE IN FLUORINE AIR POLLUTION STUDIES. J. Air Pollution Control Assoc., 7(2):88-91, Aug. 1957. 11 refs.

The exposure of lime-treated filter papers under protection of wooden shelters has been suggested as an inexpensive technique for detecting atmospheric fluorides and delineating areas of fluoride pollution. In the present investigation, data were obtained on comparative fluoride levels in different shelters, on the relationship between average monthly lime paper fluoride levels and fluoride accumulated in herbage during the growing season, and on the reliability of the lime paper technique in measuring the relative intensity of fluoride pollution from one year to another. Under similar conditions of exposure, only small differences in fluorine content of treated papers may exist between duplicate shelters; the correlation between the fluoride in the lime papers and the ground cover vegetation for a wide range of fluoride exposure levels is high enough to predict with reasonable accuracy even the fluoride content of heteorogenous herbage throughout the growing season. The reliability of the lime papers in measuring relative fluoride pollution from one year to the next was substantiated when observed diminuations in fluoride pollution reflected by comparative lime paper fluoride levels were found to be due to a reduction of fluoride emissions rather than variations in wind patterns.

25952

Silverman, Louis and Mary E. Shideler

SPECTROPHOTOMETRIC DETERMINATION OF BERYLLIUM AND FLUORIDE USING CHROME AZUROL S. Anal. Chem., 31(1):152-155, Jan. 195⁰. 14 refs. (Presented at the American Chemcial Society Meeting, 132nd, New York, Sept. 1957.)

Chrome Azurol S (the sodium salt of 3'-sulfo-2',6-dichloro-3,3'- dimethyl-4-hydroxyfuchson-5,5-dicarboxylic acid) was applied to the spectrphotometric determination of beryllium and fluoride. The colored beryllium-Chrome Azurol S complex is formed at pH 6.0 in the presence of a pyridine-hydrochloric acid buffer, which enhances the sensitivity of the dye to beryllium and increases the sensitivity of the metal-dye complexes to fluoride. The procedure described can be used to determine from 1 to 30 gamma of fluoride per 50-ml vol with a precision of plus or minus 1 gamma, and from 0.2 to 10 gamma of beryllium per 50 ml vol with a precision of plus or minus 2 gamma. Studies were made on the variables of the system, interferences, and on an ion exchange method of separate uranium form beryllium. (Author abstract modified)

26121

Nakazawa, Akira

ON HYDROGEN FLUORIDE AIR POLLUTION MONITORING DEVICE. (Fukka suisogasu taiki osen kanshi sochi ni tsuite). Text in Japanese. Bunseki Kiki (Analysis Instr.), 8(8):546-549, Aug. 1970.

In a new device for analyzing hydrogen fluoride, air to be tested is continuously exposed to the reagent, the chlorate solution of zirconium eriochrome cyanine R. In proportion to the concentration of fluoride in atmosphere, zirconyl fluoride is produced, and the reagent loses its color. The degree of color los is measured by a colorimeter to obtain the amount of fluoride in th atmosphere that came in contact with the reagent. The analyzer, which is illustrated in a flow diagram, has the dimension 90 by 40 by 40 cu cm and weighs 60 kg. Its operation requires 100V AC and about 300W power. Control, measurement, reagent tank, and power as well as pump sections are all housed in one cabinet. The measurement section includes the colorimeter among other mechanisms The operation of the analyzer consists of setting the timer (100 min), adjusting the air intake to 10 l/min, and letting the machine auto-

matically record the concentration of fluoride in the atmosphere. The value of concentration can be obtained by comparin the data to the calibration line. An example of a measurement is shown; the concentration is almost zero at night, and increases fro morning to the afternoon and decreases in the evening. The reliability of the device is accurate to 1 ppb, and can also be use for measuring trace amounts of gases such as sulfur dioxide, chlorine, and nitrogen oxides.

26122

Yamate, Noboru

MEASUREMENT OF GASEOUS AIR POLLUTION. (Gasujo taiki osenshitsu no solutei). Text in Japanese. Bunseki Kiki, (Analysis Instr.), 8(8):536-545, Aug. 1970. 34 refs.

Manual and continuous methods of measuring the major gaseous pollutants are reviewed. Manual methods employed for analyses of sulfur oxides are the rosaniline, molybdic acid-barium, lead peroxide, and detector filter paper methods. Continuous methods ar the iodine starch-light absorption, rosaniline light absorption, an electroconductivity methods. The Saltzman and naphthylethylene diamine methods are employed for manual analyses of nitric oxide and nitrogen dioxide; and the Saltzman light absorption method is used for continuous analysis. Carbon monoxide is manually analyzed by infrared analysis, gas chromatography, detector tubes, and the hopcalite method; it is continuously analyzed by infrared analysis, gas chromatography, the mercuric oxide method, and the hopcalite method. The manual method of analyzing hydrogen sulfide is the methylene blue method; the continuous method; and the filter paper coloring method. Hydrocarbons are measured manually be gas chromatography and continuously by hydrogen flame ionization. Aldehydes are measured manually by the chromotropic acid, acetylacetone, and MBTH methods; and continuously by the light absorption method. Ozone and all oxides are measured manually by the iodimetric and phenolphthalein methods and continuously by the coulometric and light absorption methods. The thorium neotrine and lanthanum alizarine complex methods are used for manual measurements of fluorine compounds; fluorescent and light absorptio methods are used for continuous measurement. The orthotolysin and light absorption methods are used, respectively, for manual and continuous analyses of chlorine. Respective manual and continuous methods of measuring hydrogen chloride are the thiocyanic acid- mercuric salt and electroconductivity method. The manual method for hydrogen cyanide is the pyridine-pyrazolone method. For manual measurements of hydrogen cyanide, the Indo-phenol and Nessler methods are employed.

26203

Heuser, Stanley G.

VOLUMETRIC DETERMINATION OF CONCENTRATIONS OF SULFURYL FLUORIDE IN AIR. Anal. Chem., 35(10):1476-1479, Sept. 1963. 4 refs.

The reaction of the fumigant sulfuryl fluoride with alkalies is discussed, and two volumetric methods of determining its concentration in air are described. The first method involves titration of excess NaOH with 0.05N HCl, using thymolphthalein as indicator. The second method involves titration of excess barium hydroxide with 0.1N HCl, again with thymolphthalein as indicator. In the first method, the amount of carbon dioxide absorbed by the reagent has to be calculated by direct titration of excess alkali in another aliquot of the sample. In the second method, CO2 presen in the atmosphere is precipitated as barium carbonate together with the fluoride. If determination of CO2 is not required, titration with HCl is replaced by direct addition of a standard amount of acid in excess to sample and reagent blank. The amount of SO2F2 present is then obtained directly by difference in titrations with 0.02N Ba(OH)2. Recoveries of SO2F2 in normal air by both methods are tabulated, as are results obtained by the first method when 1.5 to 2.5% by volume CO2 was present. Collectively these results show substantially correct recoveries of the two gases by either method, either individually or in admixture without mutual interference. However, the second method is preferred for accurate measurements of low concentrations of SO2F2, since the calculation is made independently from that for CO2.

26209

Spindler, Donald C. and Mona Franck Smith

SPECTROCHEMICAL DETERMINATION OF FLUORINE IN PORCELAIN ENAMEL FRITS. Anal. Chem., 30(9):1330-1332, Aug. 1958. 8 refs.

Porcelain enamel frits, which are the basic material for porcelain enameling, are selected glasses of widely varying composition. These molten glasses are fritted by air or water quenching to form brittle flakes or granules. Fluorine may be added to a glass batch as an alkali silicofluoride or fluorspar. Fluoride aids in smelting the raw bath and increasing the opacity of zircon enamels. Fluorine losses occur during smelting as silicon tetrafluoride, boron trifluoride, and alkali fluorides. Rapid comparison of porcelain enamel frits is facilitated by spectrochemical determination of fluorine. Calcium carbonate and graphite are mixed with the sample to produce calcium fluoride bands. The intensities of the band head at 5291.00 A, corrected for background are compared with those of chemically analyzed standards. The range of fluorine covered is from a few tenths to 6% in frits. Som factors considered are the emulsion, amperage, time of exposure, and band components. Various amounts and kinds of additives are evaluated. (Author abstract modified)

26259

Yasuda, Stanley K. and Jack L. Lambert

CELLULOSE SUPPORTED THORIUM-ALIZARIN RED S REAGENT FOR FLUORIDE ION DETERMINATION. Anal. Chem., 30(9):1485-1489, Sept. 1958. 14 refs.

The reagent and procedure described are the result of a study of colorimetric methods to produce color in solution directly proportional to fluoride ion concentration. Fluoride ion in concentrations to 15 ppm reacts selectively with the reagent to release the thorium-Alizarin Red S chelate (absorption maximum, 520 micrograms) into solution. Concentration limits for a number of possible common interfering ions were determined. A polymeric structure of the reagent and a mechanism for the ion exchange reaction are proposed. The combining ratio of thorium to dye was 1 to 2 by gravimetric and spectrophotometric methods. Chelation of thorium through a carbonyl oxygen and the 1-hydroxy group in the Alizarin Red S was substantiated by infrared absorption data. The method should be convenient for rapid visual or spectrophotometric determination of fluoride ion within the conditions specified. (Author abstract modified)

26396

Ivie, J. O., L. F. Zielenski, M. D. Thomas, and C. R. Thompson

ATMOSPHERIC FLUOROMETRIC FLUORIDE ANALYZER. J. Air Pollution Control Assoc., 15(5):195-197, May 1965. 7 refs.

A fluoride analyzer is described which can be operated for longer than six months with virtually no maintenance and which measures atmospheric hydrogen fluoride in the sub-ppb range. Parallel air streams are drawn into the analyzer through glass tubes, one coated with NaHCO3 and the other clean. The coated tube absorbs hydrogen fluoride, but the clean tube allows it to pass. The air streams are drawn through adjacent spots of sensitized paper tape made by dipping chromatography paper in MgOH solution of 8-hydroxyquinoline and magnesium acetate. The resulting magnesium salt of 8-hydroxyquinoline fluoresces when illuminated with ultraviolet light. The visible fluorescence is quenched by hydrogen fluoride, thus providing a quantitative measure of fluoride. The differences is emitted light from the two areas of a tape is monitored by reflecting the two beams of light on balanced photomultiplier tubes. In field measurements, satifactory correlation has been found between average daily values obtained with the automatic analyzer and impingers.

26400

Nichol, A. A., H. M. Benedict, J. L. Byrne, and C. P. McCarty

THE DETERMINATION OF THE FLUORIDE CONTENT OF NATURAL VEGETATION. J. Air Pollution Control Assoc., 6(4):239-243, Feb. 1957. 1 ref. (Presented at the 49th Annual Meeting of the Air Pollution Control Association, Buffalo, N. Y., May 20-24, 1956.)

Procedures are described for carrying out a valid sampling and analytical program to determine how far from a source fluorides are found in plants in concentrations sufficient to cause injury to livestock. Subjects include selection of species and sampling sites, portion of the plant and amount of material to be collected, sampling errors, preparation for analysis, moisture determination, and storage factors. The standard Willard and Winte method for analysis of fluoride in vegetation is reviewed, as well as sources of analytical errors, and the use of specially prepared standard samples for checking the chemical analysis results. Plotting the analytical results on a map and drawing isofluors to connect points with the same fluoride concentrations will produc a map which makes it possible to ascertain at a glance how far from a source the fluoride concentration has been raised above the safe feeding level. The results may also be used to evaluate the effectiveness of emission controls and to indicate emission reductions necessary to produce desired distribution limits, but interpretation must take into effect seasonal variations, in plant concentrations caused by periods of rapid or slow growth of the plant.

26485

Bertolacini, R. J. and J. E. Barney, II

ULTRAVIOLET SPECTROPHOTOMETRIC DETERMINATION OF SULFATE, CHLORIDE, AND FLUORIDE WITH CHLORANILIC ACID. Anal. Chem., 30(1):202-205, Feb. 1958. 9 refs. (Presented at the Conference on Analytical Chemistry and Applied Spectroscopy, 8th, Pittsburgh, Pa., March 1957.)

Time intense absorption of solutions of chloranilic acid in the ultraviolet region provides the basis for the spectrophotometric determination of trace amounts of sulfate, chloride, and fluoride. Sulfate is determined by reaction with barium chloranilate in 50% ethyl alcohol, buffered at pH4 (absorption measured at 332 micrograms); chloride, with mercuric chloranilate in 50% methyl Cellosolve and .05N in nitric acid (absorption measured at 305 micrograms); and fluoride, with strontium chloranilate in 50% isopropyl alcohol, buffered at pH4 (absorption measured at 332 micrograms). Limit of detection is 0.06 ppm for sulfate, 0.05 ppm for chloride, and 5 ppm for fluoride. The procedures for sulfate and chloride provide greater sensitivity, with fewer interferences, than currently available methods. The procedure for fluoride is subject to interference from most anions but rapid in limited routine uses. The method can be applied to other anions. (Author abstract)

26692

Howard, O. H. and C. W. Weber

A PORTABLE CONTINUOUS ANALYZER FOR GASEOUS FLUORIDES IN INDUSTRIAL ENVIRONMENTS. A.M.A. Arch. Ind. Health, 19(3):355-364, March 1959. 1 ref.

Details are given of the development and design of an inexpensive portable fluoride analyzer for the continuous monitorin of fluorides in working atmospheres. The instrument is based on the fact that the current from an aluminum-platinum 'internal electrolysis' cell is a function of the fluoride content of an acetic acid electrolyte, after the sampled air has been scrubbed with the electrolyte. Thus, controlled flows of the fluoride- contaminated air and an electrolyte-scrubbing solution are passed concurrently through a scrubber where the fluoride is absorbed into the solution. The air then exhausts to the atmosphere while the solution flows through a detector cell containing aluminum and platinum electrodes. The resulting current is a function of the fluoride concentration of the air and can be measured on a simple microammeter, recorded on a strip-chart recorder, or used to actuate an alarm device. In-plant results reveal concentration peaks not resolved by present methods of analysis. The analyzer responds to all substances which form fluoride ion in aqueous solution and is specific for fluoride in the presence of common air contaminants, including chloride below 100 microgram per liter. The range of the instrument is 0.1 to 10 microgram of fluoride per liter of air with a higher upper limit available through proper selection of air and solution flows. Modification is expected to make the instrument applicable to air pollution levels of parts per billion.

26707

Saltzman, Bernard E.

REPORT ON INTERSOCIETY COMMITTEE FOR DEVELOPMENT OF MANUAL OF METHODS FOR AMBIENT AIR SAMPLING AND ANALYSIS. J. Assoc. Offic. Anal. Chemists, 52(2):349-350, 1969.

The major activity of committee and subcommittee meetings of the Association of Official Analytical Chemists during the past year has been concerned with a manual of methods for ambient air sampling and analysis. After final editorial revisions for format and style, methods will be available for publication as follows: arsenic, silver diethyldithiocarbamate method; benzo(a)pyrene, thin layer chromatography, spectrophotofluorometric determination, and spectrophotometric determination; benzo(a)pyrene and benzo(k)fluoranthene, column chromatography and spectrophotofluorometric determination; chloride, mercuric nitrate titration; fluoride, autoanalyzer and lanthanum-alizarin; fluoride, manual and titrimetric and spectrophotometric procedures; nitrogen dioxide manual spectrophotometric procedures; lead-210, beta counting of bismuth-210 daughter; radon-222, filter paper, alpha and beta counting, charcoal adsorpion, alpha and gamma counting. Twelve additional methods which are in the final stage of approval by the Intersociety Committee deal with carbon monoxide, chlorine, formaldehyde, aromatic hydrocarbons, lead, and sulfur dioxide.

26713

Council for Scientific and Industrial Research, Pretoria (South Africa), Air Pollution Research Group

ANNUAL REPORT 1969-1970. APRG-2, 14p., 1970. 25 refs.

The present task of the Air Pollution Research Group is to gather facts, to maintain a well-run monitoring and measuring system, and finally, to observe the trends in air pollution and understand thei causes. Information obtained in this manner can serve as a basis upon which decisions can be made and control measures can be taken in South Africa by the authorities concerned. During the past year a study of mathematical representations of the ways in which pollutants are dispersed from factory stacks has been completed. A new light weight temperature measuring radiosonde has been develope and constructed. The national air sampling network has been expanded to include two additional towns so that monitoring of smok and sulfur dioxide is now being done in seven major cities and town in South Africa. A recent survey made in Johannesburg has once again demonstrated that the smoke emission from diesel vehicles in South Africa is substantially larger than that from vehicles in Europe. Two new studies have been undertaken, one which is concerned with the identification and measurement of trace elements in urban and industrial environments, and another which is aimed at the identification of gaseous organic pollutants in order to reveal the presence of undesirable but thus far unidentified pollutants. Some twenty trace elements, including lead, magnesium, vanadium, barium, chromium, and cobalt, have been identified in the atmosphere of Pretoria. The mobile laboratory which has been used for the survey of traffic pollutants has been equipped also for the measurement of nitrogen oxides. A smoke survey made in Pretoria revealed some of the primary smoke sources, and a study of the effect of fluoride on sugar cane has produced novel information on the reaction of the cane plant to fluoride. Finally, micro-meteorological surveys were carried out at various sites proposed for industrial development.

26729

MEASUREMENT IN PLANTS. (Messungen in Werken). Translated from German. Belov and Associates, Denver, Colo., 6p., Nov. 10, 1970.

Earlier measurements with an infrared analyzer showed that sulfur dioxide emissions from a cement oven increased when the concentration of alkali oxides evaporating from the fuel was too low to bind the SO2 formed in the gas phase of the oven to potassium sulfate or sodium sulfate. There was a linear relationship between the alkali/sulfur balance and the analytically determinable composition of the oven gas phase and the SO2 emission. These findings were confirmed by six further balance measurements on four Lepol ovens and two gas suspension heat exchange ovens. In related experiments, crude powder, fuel, clinker, and dust, removed within the limits of the alkali/sulfur balance measurements, were examined for their fluor content. Many times the percentage of the fluors brought into the cement clinker, and the corresponding 2 to 13% in the oven dusts, were determined to be bound. As a rule, the lower the dust circulation in the oven, the higher in the fluor binding in the clinker.

26744

Nielsen, Harold M.

THE DETERMINATION OF FLUORIDE IN SOFT TISSUE, BONE, AND URINE. A.M.A. Arch. Ind. Health, 21(4):316-317 April 1960. 8 refs.

Although the Willard-Winter procedure is a reliable means for isolating fluoride from ions that interfere with its estimation by titrimetric and spectrophotometric procedures, fairly large amounts of distillate must be collected to ensure quantitative recovery. An ion-exchange procedure is described to concentrate the fluoride to a volume which can be measured accurately. Resin in the chloride form is added to a column 1 cm in internal diameter and 2.5 cm in height. The resin is converted to the acetate form by percolation through 25 ml of a solution (1 M) of sodium acetate, swelling to a height of about 3 cm. A suitable column for tissue analysis is made by fusing a 3 inch length of borosilicate glass tubing to the bottom of a 28 by 200 mm culture tube. These 200 ml columns, with reservoirs of about 30 ml capacity, are used for the determination of fluoride in bone and urine. Fluoride is estimated by the Megregian method. Reagent A is 0.1% of eriochrome cyanine R in distilled water, and reagent B is 0.0175% of zirconyl nitrate dihydrate in 1:1 hydrogen chloride. Calcium and phosphate in bone can also be determined in the same sample.

26909

Miller, V. L., D. F. Allmendinger, Folke Johnson, and Dorothy Polley

LIME PAPERS AND INDICATOR PLANTS IN FLUORINE AIR POLLUTION INVESTIGATIONS. Agr. Food Chem., 1(7):526-529, June 24, 1953. 9 refs. (Presented at the American Chemical Society Northwest Regional Meeting, Pullman, Washington, June 12-13, 1953.)

Industrialization has increased the possibility of air contamination for effluent fluoride in a number of areas in the state of Washington. An inexpensive method for detecting atmospheric fluoride and delineating areas where it may be an economic factor with respect to farming is represented by the use of lime-treated filter paper and gladious plants, whose growing season substantially corresponds to that for forage in western Washington. The correlation between fluorine in forage and that in exposed lime paper and gladiolus leaves is shown to be above that required for statistical significance. Similarly, the correlation between fluorine in lime paper and gladiolus and injury index of gladiolus is such that fluorine in gladiolus or the injury index can be predicted with a high degree of accuracy from the fluorine content of lime paper. This method of investigation may prove valuable in locales where uniform coverage of an area is desired or where no vegetation is available for sampling atmospheric fluoride on a year-round basis.

26952

Okita, T. and M. Mori

AN ATMOSPHERIC HYDROGEN FLUORIDE RECORDER EMPLOYING DRY COLLECTION AND ION ELECTRODE. Preprint, Inst. of Public Health, Tokyo (Japan) and Denki Kagaku Keiko Co. (Japan), 7p., 1970 (?).

A new instrument for measuring concentrations of hydrogen fluoride in air can clearly distinguish concentrations on the order of 1 ppb and also accurately measure concentrations of 5-6 ppb. Air is drawn in through a spiral tube and the hydrogen fluoride gas is collected on a dried alkali coating applied to the tube surface. The collected hydrogen fluoride is then washed off by a buffered solution and carried to the measuring cell, where the electromotive force is measured by fluorine ion activity electrodes. The spiral tube and dry collection method reduce the errors associated with th bubbling method of collection, while the fluorine ion activation electrodes have a high degree of selectivity. When air was sampled at 30 l/min for one hr, 1 ppb consistency of atmospheric hydrogen fluoride gas was recorded at 24% and 5 ppb at 62%.

26981

Howard, O. H. and C. W. Weber

A PORTABLE CONTINJOUS ANALYZER FOR GASEOUS FLUORIDES IN INDUSTRIAL ENVIRONMENTS. A.M.A. Arch. Ind. Health, 19(3):355-364, March 1959. 1 ref.

An inexpensive portable fluoride analyzer which was developed for the continuous monitoring of environmental atmospheres is described The design and development of the analyzer are discussed and inplan results which revealed fluoride concentration peaks that are not resolved by present methods of analysis are presented. The instrument is based on the fact that the current from an aluminum- platinum 'internal electrolysis' cell is a function of the fluoride content of an acetic acid electrolyte, after the sampled air has been scrubbed with the electrolyte. The analyzer responds to all substances which form fluoride ion in aqueous solution and is specific for fluoride in the presence of common air contaminants, including chloride below 100 micrograms per liter. The range of th instrument is 0.1 microgram to 10 micrograms of fluoride per liter of air with a higher upper limit available through proper selection of air and solution flows. The analysis is precise to plus or minus 7% of the measured equilibrium value at the 95% confidence level. The lag is about 3 minutes for reaching 75% of the total signal change. The instrument, which could be used with an alarm device, is capable of continuous operation for indefinite periods, with attention limited to replenishment of the scrubbing solution every 30 hours and renewal of the recorder chart. (Author summary modified)

27044

Hendrickson, E. R.

AIR SAMPLING. In: Air Pollution. Arthur C. Stern (ed.), Vol. I, New York, Academic Press, 1962, Chapt. 11, p. 389-433. 50 refs.

Problems encountered in sampling and common equipment needs are reviewed, and specific methods of sampling aerosol contaminants and gaseous contaminants are individually discussed. The aerosol sampling methods evaluated include filtration, impingement, sedimentation, electrostatic precipitation, and centrifugal methods; the gaseous contaminant sampling methods include adsorption, absorption, freezeout, and grab sampling techniques. Also reported are simplified techniques helpfut in providing preliminary information on sulfur dioxide, gaseous fluorides, hydrogen sulfide, and ozone.

27130

Schneider, W. and E. Schoffmann

COMPARATIVE INVESTIGATIONS OF FLUORINE-CONTAINING IMMISSIONS. (Verleichende Untersuchungen uber Fluorhaltige Immissionen). Staedtehygiene (Uelzen/Hamburg), 19(6):114-115, June 1968. 5 refs. Translated from German. Belov and Associates, Denver, Colo., 5p., Nov. 19, 1970.

In the past, fluorine determinations were assumed to be reliable if damaged leaves were ascertained to have a higher fluorine value than similar samples from unexposed areas. However, as determined by fluorine ssampling in a wooded recreation area, an increased fluorine content in ashed plant leaves neither demonstrates the occurrence of fluorine compounds in air nor the cause of plant damage. Since the most frequently occurring fluorine compound, calcium fluoride (fluorite), appears only as dust, dust precipitation measurements should be carried out. Because these dusts would be trapped in thick tree stands, the selection of measuring stations should be carefully evaluated. In heavily wooded areas, no fluorine concentrations worth mentioning can be determined from air sampling.

27131

Blyum, I. A. and D. P. Shcherbov

ESTIMATION OF THE SENSITIVITY OF FLUORIMETRIC DETERMINATION. J. Anal. Chem. USSR (English Translation from Russian of: Zh. Anal. Khim.), 22(4):584-589, May 1967. 15 refs.

The sensitivity threshold of fluorimetric determinations is set by two independent values--the 'instrumental' and 'analytical' sensitivity thresholds. A method is suggested for computing these values and assessing them experimentally. Based on the application of the method to fluorimetric determination of basic dyes, the sensitivity of a determination can be improved by reducing the analytical threshold through improvement of the stages involved in chemical preparation of reagents. Equations are given for choosing optimum conditions for any reagent or for making a comparison between reagents of the same type. In general, the value of the analytical threshold is approximately proportional to the ratio of the analytical background and calibration factor. (Author abstract modified)

27248

Organization for Economic Co-operation and Development, Paris (France), Air Management Research Group

TECHNICAL PROBLEMS IN MEASUREMENT AND MONITORING. Rept. EX.40131, 61p., Feb. 10, 1970. 89 refs.

Factors influencing the research policy on the measurement and monitoring of air pollution include recognition of the internal combustion engine as a major source, routine monitoring of specific industrial pollutants, potentially hazardous occupational conditions, atmospheric tracing and fluctuating levels, and recent developments in technology. Emerging administrative requirements of measurement are discussed, as well as priorities in research. Continuous monitoring networks are described, and predictive models are considered. Sampling and analytical techniques for asbestos, carbon monoxide, fluorides, heavy metals, fuel additives, organic compounds, nitrogen oxides, oxidants and ozone, sulfur compounds, odors, and pesticides are presented, including spectrometry, fluorescence, polarography, chromatography, Saltzman method, iodimetric methods, photometric methods, and others. Current research on the measurement of particulates below 10 micron is described. Emission inventories are described, and the principal areas of deficiency in technical capabilities are disclosed.

27294

Stern, A. C., A. D. Brandt, P. M. Giever, L. Greenburg, E. R. Hendrickson, J. V. Crable, B. E. Saltzman, G. J. Kupchik, and M. Katz

ABSTRACTS OF TENTATIVE METHODS ADOPTED BY THE INTERSOCIETY COMMITTEE ON MANUAL OF METHODS FOR AMBIENT AIR SAMPLING AND ANALYSIS. J. Assoc. Offic. Anal. Chemists, 54(1):223-237, Jan. 1971.

Tentative methods adopted by the Intersociety Committee for the analysis of air samples are abstracted from the following issues of Health Laboratory Science: vol. 6, no. 2(1969) and vol. 7, no. 1 (1970). The methods concern the arsenic content of atmospheric particulate matter; the chloride, fluoride, lead-210, nitrogen dioxide, radon-222, and sulfur dioxide content of the atmosphere; the continuous monitoring of atmospheic oxidant with amperometric instruments; through C5 atmospheric hydrocarbons; polynuclear aromatic hydrocarbon content of atmospheric particulate matter; microanalysis for benzo(a)pyrene in airborne particulates and source effluents; chromatographic analysis for benzo(a)pyrene and benzo(k)fluoranthene in atmospheric particulate matter; spec-

trophotometric analysis for benzo(a)pyrene in atmospheric particulate matter; preparation of carbon monoxide standard mixtures; carbon monoxide, formaldehyde, antimony and selenium content of the atmosphere; gross alpha radioctivity of the atmosphere; gross beta radioactivity of the atmosphere; and iodine-131 content of the atmosphere.

27330

Nielsen, J. P. and A. D. Dangerfield

USE OF ION EXCHANGE RESINS FOR DETERMINATION OF ATMOSPHERIC FLUORIDES. A.M.A. Arch. Ind. Health, 11(1):61-65, Jan 1955. 2 refs.

Methods for the determination of fluorides in the atmosphere in the O to 10 parts per billion range are only partially satisfactory because of the minimum quantity which must be present in the sample if accurate results are to be obtained. This requirement leads to long, expensive sampling periods and makes it impossible to obtain information on short-time variations in the fluoride concentration. An analytical procedure is presented which involves the absorption of fluoride ion on an anion exchange resin, followed by elution with a small volume of sodium hydroxide. This enables the analyst to eliminate interfering cations and to concentrate all the fluoride into a small volume of solution withou evaporation. The usual isolation of fluoride for titration by distillation is eliminated, along with the variable reagent and system blanks. The method was used in a study of the efficiency of removal of particulate and gaseous fluoride from the air passing through experimental greenhouses. (Author abstract modified)

27331

Willard, Hobart H. and Charles A. Horton

FLUOROMETRIC DETERMINATIONS OF TRACES OF FLUORIDE. Anal. Chem., 24(5):862-865, May 1952. 15 refs. (Presented at the Southwide Chemical Conference, Atlanta, Ga., Oct. 16-18, 1950.)

Two fluorometric methods were developed for determining trace amounts of fluoride with greater sensitivity than is possible with the common colorimetric methods. Both methods depend on the competitive complexing of aluminum by fluoride and organic reagents which fluoresce with aluminum. One method is based on the fluorescence of aluminum oxinate in chloroform extracts. Maximum fluorescence for 1 micromole of aluminum or less in 50 ml of chloroform is obtained at pH 4.7 and with an oxinate concentration of 0.025%. The method detects 0.5 to 20 micrograms of fluoride; but its precision is adversely affected by the necessity of extraction and by interfering ions. The second method is based on the decrease in fluorescence of an aluminum-morin complex measured in 50% alcohol at pH 4.9. The method will estimate down to 0.2 micrograms of fluoride with excellent precision. For low fluoride ranges, the aluminum content of the complex should be 27 or 25 micrograms per 100 ml. Precision of the method at both concentrations for sodium fluoride solutions is noted.

27341

Levaggi, D. A. and M. Feldstein

MICRODETERMINATION OF FLUORIDE IN VEGETATION BY OXYGEN BOMB COMBUSTION AND FLUORIDE ION ELECTRODE ANALYSIS. Preprint, Air Pollution Control Assoc. Pittsburgh, Pa., 17p., 1970. 9 refs. (Presented at the Air Pollution Control Association, Annual Meeting, 63rd, St. Louis, Mo., June 14-18, 1970, Paper 70-66.)

A procedure for the microdetermination of fluoride in vegetation is proposed which utilizes the oxygen flask combustion technique. Fluoride analysis has been performed traditionally using the Willard-Winter method, which is lengthy and laborious, involving various steps, and large quantities of equipment. Sample size requirements are on the order of a gram or more, making the procedure useless for determining low fluoride concentrations in small samples. Thus, the fluoride selective ion electrode was investigated in combination with oxygen combustion. Gaseous products of combustion are absorbed in 10 ml of 0.05 N sodium hydroxide spiked with 1.00 microgram of fluoride. Analysis of the fluoride is performed directly on the absorption solution after addition of a combination complexing buffer solution, using a specific fluoride ion electrode. The sensitivity of the electrode is such that 0.2 microgram of fluoride can be easily detected. A complete analysis can be performed in one half hour, with a minimum amount of equipment. Added oxidant is required in the combustion step for some vegetation samples to completely free the fluoride from its organic matrix. (Author abstract modified)

27430

Benedict, Harris M.

FIELD SAMPLING FOR THE PRESENCE OF FLUORIDES IN FORAGE CROPS. Preprint, Air Pollution Control Assoc., Toronto, Ontario Section, Air Pollution Control Assoc., Pittsburgh, Pa., TR-7 Agricultural Committee, and Ontario Dept. of Energy and Resources Management, Toronto, Air Management Branch, 19p., 1970. 21 refs. (Presented at the Impact of Air Pollution on Vegetation Conference, Toronto, Ontario, April 7-9, 1970.)

A field sampling program that has been successfully used for almost 20 years to obtain information on fluorides in forage crops is described. The program uses a coordinate system for locating and identifying the sampling sites. This system provides a uniform geographic reference for all phases of the field surveillance programs; facilitates the transfer of investigational data from notebook to maps; and enables quick reference between laboratory data and geographic origin of any one sample. Methods employed to assure a representative sample and an accurate analysis are noted together with methods of tabulating analytical results into readily useable form and of interpreting the assembled data. Data are presented on monthly variation of fluoride levels in plants, the reduction of fluoride levels by rainfall, and on the comparativ fluoride content of different grass and alfalfa species.

27769

Waclawik, Jerzy and Stefan Waszak

METHOD FOR DETERMINING CONTINUOUSLY SMALL CONCENTRATIONS OF GASEOUS HALOGENATED COMPOUNDS AND OF HYDROGEN HALIDES IN AIR AND IN OTHER GASES. (Assignee not given.) U. S. Pat. 3,546,079. 3p., Dec. 8, 1970. 6 refs. (Appl. Feb. 8, 1967, 6 claims).

A method is described for continuously determining gaseous halogenated organic compounds such as trichloroethylene, tetrachloroethylene, chloroform, methyl bromide, or phosgene, and hydrogen halides such as hydrogen chloride, hydrogen bromide, or hydrogen fluoride. Known methods are mostly qualitative, laborious and time-consuming, but the present method overcomes these disadvantages by converting the halogen combined in the organic compound into a free halogen. This is accomplished by passing the compound continuously through a furnace filled with a palladium catalyst at about 800 C. Then the combustion products from the furnace are passed through a tube filled with a bromide-bromate mixture or an iodide-iodate mixture or through a washer filled

with an aqueous solution of the respective salts. Free halogen can be determined by known methods, preferably in the galvanic cell of a gas analyzer.

27927

Nielsen, H. M.

DETERMINATION OF MICROGRAM QUANTITIES OF FLUORIDE. Anal. Chem., 30(5):1009-1011, May 1958. 10 refs.

The determination of trace amounts of fluoride in the quantities found in some animal tissues is difficult, especially when the sample size must be restricted. By employing an ion exchange technique for concentrating the fluoride and freeing the solution from interfering ions, 1- to 10-gamma quantities can be estimated with a precision within 5% of the fluoride present. The procedure involves suspending a portion of anion exchange resin in chloride form in distilled water, decanting the fines, and adding the resin slurry to borosilicate tubes to make columns 2 cm in height. The resin is converted to acetate form by the addition of sodium acetate to the column, and the fluoride is removed from the resin by stepwise elution with increasing concentrations of sodium acetate, beginning at 0.1M solution. Effluent is collected in 5-ml fractions and absorbances are read in a spectrophotometer at 527.4 micrograms. Fluoride values are determined from a curve prepared by plotting absorbance readings of standard fluoride solutions made to volume with 0.2M sodium acetate solution against the concentration of fluoride. Fifty to 70 ml of 0.2M sodium acetate are required to remove interfering phosphate and 25 ml of 1M acetate to remove chloride and sulfate. Then the method is applied to the determination of fluoride in atmospheric samples, the samples need only be percolated through the resin. The fluoride is removed and estimated as outlined above.

27933

Rowley, R. J., J. G. Grier, and R. L. Parsons

DETERMINATION OF FLUORIDE IN VEGETATION. Anal. Chem., 25(7):1061-1065, July 1953. 4 refs. (Presented at the Pittsburgh Conference on Analytical Chemistry and Applied Spectroscopy, Pittsburgh, Pa., March 2-6, 1953).

There has been a general belief that fluoride can be satisfactorily recovered from ashed vegetation by double distillation, first with sulfuric acid, then with perchloric acid. Measurement of the fluoride is usually based on the reaction between fluoride and thorium nitrate in the presence of sodium alizarinsulfonate indicator. Recent work has shown that ashing of vegetation containing appreciable amounts of silica may result in unreactive combinations of fluoride, from which fluoride cannot be separated. Two modifications of eliminating low recoveries resulting from fixation associated with the ashing treatment are alkali fusion of ash and collection of 500 ml of distillate. These procedures, which are described in detail, were applied to synthetic vegetation samples (grass hay, red clover hay, timothy, and apple leaves) to which fluoride was added. The percentage recoveries are listed and noted to be satisfactory. Alkaline fusion completely liberated the combined fluoride, while a single distillation with perchloric acid was adequate for isolating the fluoride in a form suitable for measurement. The modifications described thus offer appreciable savings in time as well as increased accuracy.

27962

Svoboda, Karel and Hans Ixfeld

SAMPLING AND AUTOMATED ANALYSIS OF GASEOUS FLUORINE IMMISSIONS. (Probenahme und automatishche Analyse gasfoermiger Fluor- Immissionen). Text in German. Staub-Reinhalt. Luft, 31(1):1-8, Jan. 1971. 34 refs.

Gaseous fluorine compounds especially hydrofluoric acid are phytotoxic, air sampling thus must include all molecular disperse fluorine compounds after the removal of particulates. The electrometric fluorine determination using an ion-selective lanthanum electrode yields tests results in a form easily handled by digital computers. The electrode yields a potential which is equivalent to fluorine ion activity in the test solution washing the lanthanum fluoride membrane. Calcium fluoride or cryolite raise the potential only to the extent to which they go into solution. Metal ions present which would form fluorine complexes and thus reduce the fluoride ion activity are inactivated by a hydrochloric acid-citrate buffer of appropriate pH The standard potentials of individual lanthanum fluoride electrodes are not uniform and each electrode must be individually calibrated. A calomel electrode is used as a reference electrode in the potential determination. The lower limit of measuring range is 0.07 microg F(-)/cu m. For a fluorine content between 1 and 50 microg F(-)/cu m the standard deviation for the method is about 3.5%. The apparatus, the sampling and measuring procedure and calculation of results are described.

28102

Eguchi, T.

ELECTROCHEMICAL ANALYSIS METER. (Denki kagakushiki bunseki kei). Text in Japanese. Denshi Kagaku (Electron. Sci.), 21(2):61-70, Feb. 1971. 6 refs.

Several electrochemical devices for measuring environmental pollutants are described. One instrument incorporates the princip1 of electrolytic conductivity to measure atmospheric sulfur dioxide concentrations. Air sampled at a controlled constant speed is passed through a filter to an adsorption tube into which dilute hydrogen peroxide is continuously introduced. When present in the sampled air, SO2 reacts to form sulfuric acid, concentrations of which increase in proportion to the amount of SO2 present. Since the sulfuric acid changes the electrolytic conductivity of the solution, changes in conductivity before and after contact indicate the SO2 concentration of the sampled air. A new method for measuring electric current uses coulometric analysis to obtain a concentration of a sample by consumed electric charge when a titration reagent reacts on the sample for equivalence. This method is employed for measuring both SO2 and oxidants. A galvanic coulometric method and a polarization current method are also used to measure oxidant concentration. An ion selection electrode is used to measure fluoride and hydrogen cyanide. In combination with a calomel reference electrode, this electrode picks up the concentration of a specific ion in solution as the potential difference. Another device utilizes a fuel cell to measure nitrogen oxide and SO2 concentrations.

28126

Fukui, Shozo

MEASUREMENT OF DELETERIOUS GAS. (Yugai gasu no sokuteihoho). Text in Japanese. Preprint, Society of Electro-Chemistry, Tokyo (Japan), Kanto Div., 24p., 1971. (Presented at the Seminar on Air Pollution, Tokyo, Japan, Feb. 3-4, 1971, Paper 5.)

The photometric determination of deleterious gases is considered, as well as the analysis of heavy metals in the atmosphere by an atomic absorption method, and the determination of atmospheric concentrations of organic solvents by gas chromatography. Accordin to the type of gas to be measured, sampling and preparation of test chemical solutions are in-

dicated. Measuring procedures are presented for hydrogen sulfide, sulfur dioxide, ammonia, hydrogen fluoride, nitrogen dioxide, nitrogen dioxide plus nitric oxide, hydrogen chloride, chlorine, oxidants and ozone. The chemical analyses of heavy metals includes the determination of mercury, lead, cadmium, zinc, copper, iron, and manganese. For example, mercury vapor is absorbed in a sulfuric acid potassium permanganate solution and heated slowly for 30 min. A hydroxilamine solution is added to decolor the potassium permanganate, and a stannous chloride solution is added to reduce the mercury. Vaporized by circulating air, the mercury is absorbed by an absorption cell and measured at 253.7 millimicrons. The gas chromatograhic method is introduced for the measurement of acetone, chloroform, carbon tetrachloride, cyclohexene, tetrachloroethane, phenol, and other organic solvents in the atmosphere.

28251

Robinson, Elmer

DETERMINING FLUORIDE AIR CONCENTRATIONS--BY EXPOSING LIMED FILTER PAPER. Am. Ind. Hyg. Assoc. Quart., 18(2):145-148, June 1957. 5 refs.

During a recent Stanford Research Institute air sampling program in an area where atmospheric concentrations of fluoride existed, several experiments were carried out with the filter paper technique and compared to fluoride air sampling using water-filled scrubbers. The papers were lime treated by being soaked in a saturated solution of low fluoride lime and then oven-dried. Analyses of the filter paper for fluoride were carried out using a modified ion-exchange technique. In addition to the area which contained a large industrial fluoride source, three greenhouses wer available which were similar except for the fluoride concentrations which existed inside. The tests show that the filter papers should not normally be expected to give a quantitative picture of fluoride air concentrations comparable with that obtained by the usual air sampling techniques. However, in an area in which fluoride air concentrations are high, filter papers will usually pick up more fluoride than will papers similarly exposed in an area with lower fluoride concentrations. Changes in the conditions of exposure, either in air concentrations or wind and weather conditions, apparently alter the rate at which the filter paper picks up fluoride from the air. Some aspects of this technique, such as the relatively close agreement between papers exposed side by side over the same period, are encouraging. (Author summary modified)

28285

Pack, M. R., A. C. Hill, M. D. Thomas, and L. G. Transtrum

DETERMINATION OF GASEOUS AND PARTICULATE INORGANIC FLUORIDES IN THE ATMOSPHERE. (American Society for Testing and Materials, Philadelphia, Pa., Am. Soc. Testing Mater. Spec. Tech. Publ. no. 281:27-44, 1959. 25 refs.

Problems encountered in sampling and analyzing low concentrations of atmospheric fluorides are reviewed, and techniques are described that gave good results in extensive sampling programs. A Greenburg-Smith type impinger efficient collection of both gaseous and particulate fluorides, except possibly submicron particles. Good separation of gaseous and particulate fluorides was achieved by drawing the air sample through aluminum tubes or sodium bicarbonate-coated glass tubes. The gaseous fluorides were adsorbed on tube surface and the aerosol passed on into a subsequent impinger. Molecular membrane filters were also efficient for separating the different forms of fluoride, if properly used. Filter paper and an electrostatic precipitator gave poor separation because they picked up appreciable amounts of hydrogen fluoride along with the particulate fluoride. Hydrogen fluoride was absorbed as efficiently in water as in alkaline solution. Air samples containing only a few micrograms of fluoride can be accurately analyzed by isolating the fluoride by distillation or by use of anion exchange resins followed by titration or spectrophotometric analysis. For determining certain insoluble fluorides, distillation and titration are probably preferable. The choice of methods will depend on the concentrations of fluorides present, the objectives of sampling, equipment available, and the particular abilities of the personnel involved. (Author summary modified)

28374

Biheller, Johann and Werner Resch

A SAMPLING AND MEASURING METHOD FOR THE ROUTINE DETERMINATION OF FLUORINE IN THE ATMOSPHERE NEAR THE GROUND. (Erprobung einer Sammel- und Messmethode fuer die routinemaessige Bestimmung von Fluor in der bodennahen Atmosphaere). Text in German. Staub, Reinhaltung Luft, 31(1):9-11, Jan. 1971. 15 refs.

Since atmospheric fluorine concentrations are of the order of 1 micron/cu m, a large air sample is desirable. The method proposed aspires about 28 cu m air by a polystyrol filter impregnated with a 10% sodium formate solution in 50% alcohol designed to retain gaseous hydrogen fluoride. The diameter of the circular filter is 100 mm. Following aspiration, the filter is dissolved in ethyl acetate with a buffer and fluorine activity is determined by a fluoride-ion selective electrode. The measuring apparatus consisting of the F-electrode, the control electrode, and a pH meter must be calibrated with solutions of known F concentrations. The zero value of an impregnated polystyrol filter is approximately 0.3 micron F/dm sq filtering surface.

28441

Debiard, Raymond, Andre Fourcy, and Jean-Pierre Garrec

SOME ASPECTS OF FLUORINE DETERMINATION ACCOMPLISHED BY NEUTRON ACTIVATION OF 14 MEV IN POLLUTED PLANTS. (Quelques aspects ddu dosage du fluor par activation aous neutrons de 14 MeV dans des vegetaux pollues). Text in French. C. R. Acad. Sci. Paris, Ser. D 264(23): 2668-2671, June 5, 1967. 8 refs.

The fluorine content in polluted apple tree and grapevine leaves was determined chemically and by radioactivation of F and the results compared. The chemical analysis followed the Willard and Winter method and determined fluorine colorimetrically (fluoride ion plus cerium-alizarine complex chelate). The radioactivation method involves the activation of a vegetable sample in a flux of neutrons of 14 MeV and simultaneous gamma spectrometric measurement of F-19. Under the conditions described, 1 mg F induce 700 impulses in the gamma spectrometer. The comparative quantities determined by the two methods were in three samples, 1389 and 1471, 1343 and 1633, 1412 and 1499 mg F respectively; thus, agreement was good. The radioactivation method has the advantage of instantaneous results but cannot be used for F levels below 200 microgram per 1 g sample.

28462

Debiard, Raymond, Andre Fourcy, and Jean-Pierre Garrec

SOME ASPECTS OF FLUORINE DETERMINATION ACCOMPLISHED BY NEUTRON ACTIVATION OF 14 MEV IN POLLUTED PLANTS. (Quelques aspects ddu dosage du fluor par activation aous neutrons de 14 MeV dans des vegetaux pol-

luss). Text in French. C. R. Acad. Sci. Paris, Ser. D 264(23): 2668-2671, June 5, 1967. 8 refs.

The fluorine content in polluted apple tree and grapevine leaves was determined chemically and by radioactivation of F and the results compared. The chemical analysis followed the Willard and Winter method and determined fluorine colorimetrically (fluoride ion plus cerium-alizarine complex chelate). The radioactivation method involves the activation of a vegetable sample in a flux of neutrons of 14 MeV and simultaneous gamma spectrometric measurement of F-19. Under the conditions described, 1 mg F induce 700 impulses in the gamma spectrometer. The comparative quantities determined by the two methods were in three samples, 1389 and 1471, 1343 and 1633, 1412 and 1499 mg F respectively; thus, agreement was good. The radioactivation method has the advantage of instantaneous results but cannot be used for F levels below 200 microgram per 1 g sample.

28530

Okita, Toshikazu, Shuji Yamashita, Ryuichi Sugai, Hiromasa Nakagawa, K. Kaneda, and Masaki Mori

CALIBRATION AND FIELD TEST OF THE ATMOSPHERIC HYDROGEN FLUORIDE RECORDER. (Taikichu fukkasuiso jidokirokukei no kakuni to yagaishiken ni tsuite). Text in Japanese. Taiki Osen Kenkyu (J. Japan Soc. Air Pollution), 5(1):87, 1970. (Proceedings of the Japan Society of Air Pollution, Annual Meeting, 10th, 1970.)

Dynamic calibration of a hydrogen fluoride recorder was performed; calibration of both the collection device and the analyzer is necessary for an automatic fluoride analyzer. An appropriate HF concentration from an HF permeation tube was simultaneously led to the automatic analyzer and to an Na2CO3 filter so that measurements could be compared. The flow rate was 30 l/min for each, and the tubes were mainly of Teflon and Taigon. The correlation coefficient for the two sets of data was 0.83, and the regression equation was y equals 0.97x plus 0.25, where x constitutes measurements from the automatic analyzer and y those from the Na2CO3 filter. In a field experiment, samples were taken from aluminum electrolysis and phosphorus fertilizer plants in Naoetsu, Niigata Prefecture.

28671

Gilcreas, F. W. and E. R. Hendrickson

EQUIPMENT AND INSTRUMENTATION FOR AIR SURVEYS. Fla. Eng. Ind. Expt. Sta. Bull., no. 83:21-26, 1956. 8 refs.

Many of the important substances causing air pollution lend themselves to measurement with continuous and automatic sampling. Several instruments have been developed for continuous measurement of sulfur dioxide in the air. One of these, the Thomas Autometer, is shown schematically; the basic principle of measurement which this device employs is electrolytic conductivity. Unfortunately, other gases which may be present in the sampled air, along with sulfur dioxide, will also produce changes in the conductivity. Operation of the Autometer is described, and it is commercially available in either of two versions: the 'integrating type' and the 'nonintegrating type.' Another approach to the problem of instrumentation for sulfur dioxide sampling is the Titrilog, which operates by titration of the atmospheric contaminant with the titer generated electrolytically. A noncommercial photometric sulfur dioxide recorder uses a starch-iodine solution which is decolorized as air samples containing sulfur dioxide are bubbled through. A continuous fluoride analyzer is described. The magnesium salt of 8-hydroxyquinoline fluoresces under ultraviolet light, and it has been demonstrated that the fluorescence is quenched by minute concentrations of hydrogen fluoride. Several instruments have been described to monitor smokes, dusts, and mists, which depend on the light-scattering properties of particles in suspension.

28738

Okita, Toshiichi, Ryuichi Sugai, and K. Kaneda

SEPARATION AND SUSBEQUENT DETERMINATION OF ATMOSPHERIC PARTICULATE AND GASEOUS FLUORIDES. (Ganujo oyobi ryushijo fukkabutsu no bunriseikoteiho). Text in Japanese. Taiki Osen Kenkyu (J. Japan Soc. Air Pollution), 5(1):88, 1970. (Proceedings of the Japan Society of Air Pollution, Annual Meeting, 11th, 1970.)

The effects of gaseous fluorides (mainly hydrogen fluoride) and particulate fluorides on plants are quite different, and the separation of the two types is desirable. Separation by filters was attempted. Millipore AA filters are the most appropriate for capturing the particulates and letting the gas through 100%. A polypropylene filter allowed 50% of the particulates to penetrate and was not appropriate. Neither was Teflon LSWPO because it contained fluorine. Tests of tubes for gas capture indicated that aluminum pipes have low intake velocity and, with their length extended, can collect 100% of the gas. Collection efficiency was the best for a glass spiral containing 1% dried Na2CO3 solution.

28843

Jacobson, Jay S. and Laurence I. Heller

A SIMPLE, RAPID POTENTIOMETRIC METHOD FOR THE ESTIMATION OF FLUORID IN VEGETATION. Environ. Letters, 1(1):43-47, 1971. 3 refs.

A new method has been developed for the estimation of fluoride in vegetation, which employs a selective ion electrode for measurement of fluoride obtained by acid extraction from pulverized plant tissue. Current methods for the determination of fluoride in vegetation usually employ high temperature ashing and alkaline fusion, distillation, and analytical measurement of fluoride. These techniques are complex and time-consuming. Leaves of apple, alfalfa, barley, sorghum, several grasses and weed species, and pine needles were analyzed both by potentiometric analysis after extraction and by a standard both by potentiometric analysis after extraction and by a standard method. Statistical analyses indicate a correlation coefficient of 0.988 between measurements obtained by the new and old methods, but evidence of incomplete extraction of fluoride from tissue was found. The experimental procedure for the new technique is indicated.

29198

Serper, Allen

A LOOK AT THE METHODS FOR MEASURING AIR POLLUTANTS. Eng. Mining J., 172(4):124-128, April 1971.

The two types of measurement usually needed for airborne pollutants are source testing and air quality. Gases commonly measured by colorimetric methods include ozone, sulfur dioxide, nitrogen dioxide, and hydrogen fluoride. The principle of colorimetry is based on the measurement of the iodine released from the reaction of a particular oxidant with potassium iodide in a neutral, buffered solution. Improvements in sensitivity of coulometric titration cells have led to the development of several commercial coulometric systems for continuous SO2 monitoring. The improved version of the coulometric cell is designed to respond to bromine oxidizable or

titratable sulfur compounds that occur in very low concentrations. The iodometric system is based on the generation or liberation of iodine by ozone, and the consumption of iodine by sulfur dioxide in an iodide solution. New pollution monitors for the detection of SO2, nitric oxide, and NO2, may utilize sealed electrochemical sensors, thus requiring no handling of chemicals. With infrared analyzers, the percent of radiation absorbed is proportional to the concentration of the component of interest in the sample. Operation of an electroconductivity analyzer is based upon the principle that a noxious gas will ionize in pure water, thus decreasing the electrical resistance of the water. The basic principle of ionization analysis is the ionizatio of hydrocarbons in a hydrogen flame. Stack sampling, isokinetic sampling for particulates, and continuous monitoring systems are also reviewed.

29220

Kusumoto, Masako and Toshio Toyama

THE MICRO ANALYSIS OF FLUORINE BY THE LINEAR WASH-OUT TYPE OVEN AND ITS APPLICATION. (Senjo chushutsugata obun niyoru fusso no bunyo sokutei to sono oyo). Text in Japanese. Sangyo Igaku (Jap. J. Ind. Health), 13(2):120-127, March 1971. 30 refs.

A linear wash-out oven was developed from microanalyses of fluorides. The procedures used are similar to the ring-oven technique but with higher sensitivity in detection and with more convenient operations. Organic substances were ashed in an oxygen combustion flask, and the fluoride was detected with aluminum chromzrol S complex following recovery from interfering substances by the diffusion method. From 0.08 to 4 times 100,000 ppm were successfully quantitated with 90% recovery; the standard deviation relative to the expected amount of four repetitive measurements was less than 30%. The method was applied to fluoride determination in rice crops harvested within 10 km of an aluminum refinery. The highest concentation was found in bran powder (122 ppm). Full grains contained up to 32 ppm, while cleared grains averaged 2.91 ppm. Fluoride concentrations decreased with distance from the refinery. Fluoride in cleared grain can easily be dissolved in water, then vaporized and removed from the grain on cooking. The average fluoride intake would be 240 micrograms if the daily consumption of polluted rice totaled 1500 g. Yet this amount does not exceed the average intake of approximately 180-240 micrograms among normal adults in rural districts of Japan, the total intake daily being estimated as approximately 1.6-2.1 micrograms.

29426

Ixfeld, H.

MEASUREMENT OF FLUORINE IMMISSION IN THE NORDRHEIN-WESTFALEN STATE. (Fluor-Immissionsmessung im Lande Nordrhein-Westfalen). Text in German. VDI (Ver. Duet. Ingr.) Ber., no. 164. p. 71-75, 1971.

To determine the phytotoxic effect of fluorine concentations, the State Institute for Emission Control and Land Conservation in Essen instituted beginning with January 1971 a fluorine concentation measuring program involving about 1000 measuring stations situated between Cologne and Duesseldorf-Neuss. The measurements are discontinuous (spot checks) where the stations are near to each other, continuous where the distance between stations is considerable. The program also measures organic substances in the atmosphere by the silica gel method and dust concentration by the impactor method and by the membrane filter method. A comparison of measuring results obtained by the sorption method (sorption of gaseous fluorine compounds by silver balls coated with layers of sodium carbonate) with results obtained by the Impinger method disclosed that the latter method yielded up to 400% higher results because it also measured fluoride particles while the sorption method registered only gaseous fluorine compounds. For this reason, sampling was done with a filtering device which eliminated coarser particles. Such a preliminary filter (Herpertz-Topf filter) reduced the discrepancy between the results obtained by the two methods to 10-20%. This arrangement thus selectively measures only gaseous fluorine compounds with a maximum of 10% fluorine in particle form. Because about 200 samples have to be analyzed daily, an automatic device using lanthanum fluoride electrodes has been developed. The potentials are measured by a digital pH meter.

29467

Konno, Nobuya, Yasuko Morikawa, and Saburo Yanagisawa

EXAMINATION OF QUANTITTATIVE ANALYSIS METHOD OF FLUORINE IN VEGETABLE SAMPLES. (Shokubutsu shiryo chu no fusso teiryo ho no kento). Text in Japanese. Preprint, Japan Chemical Society, Tokyo, 1p., 1971. (Presented at the Japan Chemical Society, Annual Meeting, 24th, Tokyo, 1971, Paper 3341.)

Experiments were conducted comparing fading methods, the zirconium eleaochromecianin R (Zr. ECR) method, the lantern alizarin complexion (La ALC) colorimetric method, and the potential difference measurement method, using fluoride ion electrodes for the quantitative analysis of vegetable samples. After pulverizing the sample, calcium oxide is added, heated to 600 C, ashed (4-5 hours), dissolved in sodium hydroxide and distilled from 50% sulfuric acid, at 145-150 C to obtain 600 ml in 3-4 hours. The Zr. ECR method utilizes the fluoride ion interference with the color change. It was found that 0-1 ppm fluorine could be analyzed. Interfering ions included sulfate, bisulfate, iron, aluminum, and biphosphate. The Zr. ECR method is very rapidly affected by temperature, so that reproducibility is difficult. The La-ALC method utilizes the fact that the fluoride ion forms a complex with La-ALC, and the color is measured. The complex of La-F-ALC was extracted with N-diethylanilineisoamylalcohol, and the degree of light absorption was measured. Major interference were those which form complexes with Al, and Fe. The relationship of the logarithm of the concentration to the potential difference are linear so that at very low concentrations, a curve is formed making quantitative analysis difficult. Using a fluoride ion electrode up to 0.002 ppm was analyzed. The electrode is sensitive to Al(2+) alone, but when F(-) exists together with Al(2+), there is a large error. Of the three methods, La-ALC was superior with respect to precision and sensitivity. The ion electrode method is easier to manipulate, and is sensitive. Therefore, using both methods, sufficient sensitivity and precision can be obtained.

29737

Hermann, P.

EXPERIENCES WITH FLUORINE EMISSION MEASUREMENTS. (Erfahrungen bei Fluro-Emissionsmessungen). Text in German. VDI (Ver. Deut. Ingr.) Ber., no. 164:101-107, 1971. 12 refs.

Measurements of emissions of gaseous fluorine compounds made at som small and medium sized industrial plants within the last seven year showed results between 1 g F/hr and 1000 g F/hr. The analytical determination of small fluorine concentrations, be it by photometry or with the fluorine specific electrode, does not present any problem. No satisfactory method has as yet been found for separating particulate from gaseous compounds. Therefore, fine dust may have been included in

the recorded results of the gaseous fluorine concentration. On the other hand, it may be assumed that reactions of hydrofluoric acid with alkaline dust substances change the true record of the original gaseous fluorine emission. The development of a useful method of separating the dust from the gaseous fluorine compounds appears to be very desirable. In presen arrangements for sample taking of fluorine bearing exhaust gases in industrial plants, the gases are often being tapped prior to entering a common chimney which serves to collect waste gases from several shops. The set-up for sample taking starts with a quartz tube which adjoins the gas exhaust pipe at right angles, and can be heated up to 400 C. The gas to be tested is then lead through a quartz wool filter, into absorption bottles made of quartz and containing a caustic soda solution. A gas circulating pump and a gas meter complete the set-up.

29738

Moser, E.

MEASUREMENT OF GASEOUS AND PARTICULATE FLUORINE EMISSIONS. (Messung von gas- und staubfoermigen Fluor-Emissionen). Text in German. VDI (Ver. Deut. Ingr.) Ber., no. 164:91-99, 1971.

The emission from manufacturing plants which produce or process fluorine bearing products usually comprises a gaseous part and a particulate part. The gaseous part contains predominantly hydrofluoric acid, whereas the fluorine compounds in the dust may be composed of sodium fluoride, aluminum fluoride, cryolite, sodium silicofluoride, and calcium fluoride. With regard to the gaseous components, for instance in the case of an electrolytic aluminum smelting plant, where the emission of pollutants rises drastically at the time of metal pouring, charging of raw materials, and changing of electrodes, it is necessary to extend the sample taking at least over one complete cycle. For determination of peak concentrations, short time sampling is advised. In a plant with installed air purification, the air has to be sampled at points of entry and of exit of the purification system. An automatically working system of sample taking is described. The apparatus is divided into two groups, one of which is mounted directly next to the measuring point and comprises the filtering apparatus and gas absorption bottles, including a drip separator and a heater for the filters. The second group, connected by a hose line to the first, and conveniently located on the floor, comprises the pump arrangement with valves, thermometer, flow meter, and other necessary instruments. Tubular filters are lately being preferred to flat ones, due to their larger surface and better adaptability to the mounting of electric heaters. Absorption of gaseous HF in the bottles is best effected by a caustic soda solution.

29771

Hendrickson, E. R.

SIMPLIFIED TECHNIQUES IN AIR POLLUTION MEASUREMENT. J. Sanit. Eng. Div. Proc. Am. Soc. Civil Engrs., p. 1776-1 to 1776-8, Sept. 1958. 15 refs. (Presented at the American Society of Civil Engineers, Industrial Health Conference, Atlantic City, N. J., April 1958, Paper 1776.)

Air collection techniques for aerosols include filtration, electrostatic precipitation, thermal precipitation, or impingement; for gases and vapors, absorption, adsorption, or freeze-out are usually employed. The sample is then analyzed. Several recording instruments have been developed for common pollutants. However, practically all sampling programs are a compromise between what is desirable and what is economical or convenient. Simplified techniques generally cost less and result in cumulative indications The lead peroxide candle is a simple method for measuring sulfur dioxide. The rate of reaction varies inversely with the wind velocity. Increases in temperature and humidity also increased the reaction rate. Spanish moss and limed filter papers can determine fluoride content. Also, lead acetate impregnated papers or tiles can detect hydrogen sulfide. Another simplified technique is the use of rubber strips for the determination of ozone. The time of the rubbers cracking or crack depth can be used to indicate the amount of ozone exposure. An ozonometer is a more refined device.

29887

Biheller, Johann and Werner Resch

TESTS WITH A SAMPLING AND MEASUREMENT METHOD FOR ROUTINE DETERMINATION OF FLUORINE IN THE LOWER ATMOSPHERE. (Erprobung einer Sammel- und Messmethode fuer die routinemaessige Bestimmung von Fluor in der bodennahen Atmosphaere). Text in German. Staub, Reinhaltung Luft, 31(1):9-11, Jan. 1971. 15 refs.

A polystyrene filter impregnated with 10% sodium-formate solution in 50% alcohol was used to sample fluorine in the lower atmosphere. Preliminary results with this filter indicated that it had a high resistance, particularly at high humidity. A maximum of only 4 to 5 cu m/min air could be drawn through the filter. At low humidity, the throughput was 200 to 400 l/min. The filter was therefore modified, after which 12 experiments were carried out. For three experiments, the filter received 7.5/mg impregnation. This quantity was then raised to 15, 150, and 300/mg per filter. The experiments showed that a filter with a surface of 78.5 sq cm and containing 300/mg Na-formate absorbs more than 99% of the hydrogen fluoride present. At lower Na-formate quantities, the filter resistance drops but the percentage of HF absorbed is reduced. The content of F ion in the samples was determined by dissolving the filter in ethyl acetate, agitating with a buffer, and analysis with an F-ion selective electrode. Fluorine analyses in Graz, Linz, and Vienna show the method is highly sensitive and suitable for routine measurements.

29966

Kawaguchi, Tameharu

AUTOMATIC MEASURING APPARATUS OF FLUORIDE GASSES IN AIR. (Taiki chu no fusso-kagobutsu jidobunsekisochi ni tsuite). Text in Japanese. Taiki Osen Kenkyu (J. Japan Soc. Air Pollution), 5(1):85, 1970. (Presented at the Japan Society of Air Pollution, Annual Meeting, 11th, Japan, 1970.)

Zirconium oxychloride - eriochrome cyanine-R was used to form a complex; the fluoride concentration was detected by the color fading of the complex at 556 m micron by a photometer. For high fluoride concentration samples, iron-ferron reagent was used at 640 m micron. A specially designed cell, a high power amplifier, and an automatic cancellation mechanism enable the detection of 0.02 to 10 mg fluoride/cu m air.

30007

Ratcliffe, D. B., C. S. Byford, and F. T. Fabling

A METER FOR THE SITE DETERMINATION OF HYDROLYSABLE FLUORIDES IN SULPHUR HEXAFLUORIDE. Chem. Ind. (London), no. 19:509-511, May 8, 1971. 2 refs.

A monitor designed so that rapid site measurements can be made of the hydrolyzable fluoride content of sulfur hexafluoride gas in the concentration range of 0.1-1000 ppm w/w F(-) is described. Sulfur hexafluoride gas containing hydrolyza-

ble fluorides is passed into a solution of constant ionic strength buffered at ph 5.5. Any hydrolyzable fluorides present are decomposed to form a solution of fluoride ions, the concentration of which is measured with a fluoride activity electrode. By equating the concentration of the fluoride ions in the hydrolysis solution to the volume of sulfur hexafluoride gas sampled, the concentration of hydrolyzable fluorides present in the sulfur hexafluoride can be calculated. Details of design and calibration, and comparison with other methods, are given.

30014

Leithe, Wolfgang

DETERMINATION AND EVALUATION OF LOW CONCENTRATIONS OF INDUSTRIAL AIR POLLUTANTS. (Zur Bestimmung und Bewertung niedriger Konzentrationen industrieller Luftverunreinigungen). Text in German. Chemiker. Z. (Heidelberg), 95(10):452-455, 1971. 17 refs.

Common methods for the determination of small concentrations of sulfur dioxide, fluorides, oxides of nitrogen, and odorous substances are discussed. For SO2 the highly selective and sensitive West and Gaeke colorimetric method, employing rosaniline, is used. Fluorides are also determined by colorimetry, using alicarine-complexone and lanthane nitrate. Recently, fluoride-selective electrodes have also been used. For the analysis of NO2 and NO, sensitive methods are available which uses azo dyes. More recently the so-called Saltzman-reagent, N-(1-naphthyl)-ethylene diamine and sulfanilic acid, has been preferred. Gas chromatography is used to determine odorous substances. The sensitivity of this method could be greatly increased by the recently developed technique of reversion gas chromatography. The substances to be analyzed are concentrated in a tube which is filled with a suitable adsorption agent. The beginning and the end of the tube filling can be cooled and a heating sleeve can be moved across the entire tube. The method operates periodically and a complete chromatogram is obtained every 15 min. In the first period, the air sample is passed through the tube with the two cold zones in action. In the second period, the heating sleeve is moved across the tube at a speed which is below the sampling speed.

30300

Habel, K.

EXPERIMENTS FOR SEPARATION OF GASEOUS AND SOLID FLUORINE COMPOUNDS IN EMISSION MEASUREMENTS. (Versuche zur Trennung von gasfoermigen und festen Fluorverbindungen bei Emissionsmessungen). Text in German. VDI (Ver. Deut. Ingr.) Ber., no. 164:85-89, 1971.

In the last 20 years, the main area of interest with regard to emissions originating from iron and steel industries has been dust and sulfur dioxide. A variety of methods of measurement were developed and perfected. The handling of fluorine emissions, however, has been dealt with only more recently. It confronts the researchers with problems which are substantially different from the SO2 testing, largely because of the chemical properties of fluorine, the most reactive electronegative element. Due to its secondary valences, it easily forms several addition and complex compounds and combines readily with other elements to form stable compounds. Methods are available for the analytical determination of the overall fluorine content in solid and liquid materials, even in smallest concentrations. However, in view of the different behavior of gaseous and solid fluorine compounds, it appears desirable to separate the two. In this connection, a test set-up for waste gases was developed which includes a filter of quartz glass fiber material for retaining the dust particles. The size of the filter is MF150, and it will retain particle sizes from one micron up. For gas absorption, the waste gas stream passes through two or more impingers. Also included in the flow system is a heating mantle which surrounds the filter which dries the gas mixture and keeps the filter dry, the reason being that at increased humidity, gaseous fluorine compounds are being partly adsorbed by the components of the test system. This has to be counteracted to avoid greatly incorrect measurement results. Since the rate and volume of gas flow is being recorded by a gas meter, the values of fluorine concentrations established by analysis can be readily converted and expressed in mg/cu m of the tested gas.

30432

Sutter, Ernst

DUST MEASUREMENT AT THE PNEUMATIC APPLICATION OF CONCRETE (GUNIT TORKRET) IN UNDERGROUND CONSTRUCTION SITES. (Staubmessungen beim Auftragen von Spritzbeton (Gunit, Torkret) in Untertagebauten). Text in German. Staub, Reinhaltung Luft, 31(2):56-57, Feb. 1971. 3 refs.

Dust generated by the pneumatic application of concrete was measured because of the occurrence of several cases of silicosis among the workers. A microsorban filter (diameter nine cm) and a standard impinger were used for sampling. The air throughput was three to six cu m/hr with the microsorban filter and 1.7 cu m/hr with the impinger. After dust was determined, the quantity the dust samples were subjected to a sedimentation analysis for determination of grain size distribution. Absolute alcohol was used as a dispersion fluid. The approximate quartz content of the samples was determined by evaporation with hydrofluoric acid and microscopically in the phase contrast. Measurements were taken at six different places. An average dust concentration of 50 mg/cu m was measured, of which 15 mg/cu m belonged to fine dusts of less than five micron.

30793

Mascini, Marco

ION-SPECIFIC FILM ELECTRODES: A NEW ANALYTICAL METHOD FOR MEASURING WATER AND AIR POLLUTANTS. PART II: DATA OBTAINED FROM ANALYSIS WITH FILM ELECTRODES AND INDUSTRIAL EQUIPMENT. (Elettrodi a membrana specifici per ioni: una nuova metodologia analitica per la misura degli inquinanti dell acqua e dell aria. 2. Risultati analitici con elettrodi a membrana e modelli industriali d impiego). Text in Italian. Inquinamento, 13(2):21-29, March 1971. Part I. Ibid., 13(1), Jan.-Feb. 1971.

Ion-specific film electrodes are prepared by pulverizing insoluble salts containing the ion that is of interest to the researcher, and intimately mixing this powder with a thermoplastic polymer which is then pressed out to form a very compact film in a heat presser at a temperature of about 100-150 C and a pressure of about 200-300 atm. This film is then welded to a tube made of the same polymer as that contained in the film. Experimental data are given for tests with electrodes specific for halide, sulfide, silver, and cyanide ions. Practical application is made to the determination of hydrogen fluoride gas contained in the stack gases of an aluminum plant, using polarographic measurements.

30840

Katz, Morris

ANALYSIS OF INORGANIC GASEOUS POLLUTANTS. In: Air Pollution. Arthur C. Stern (ed.), Vol. 2, 2nd ed., New York, Academic Press, 1968, Chapt. 17, p. 53-114. 103 refs.

Inorganic gaseous pollutants represent an important class of substances in analysis of samples for air pollution control purposes and for the assessment of ambient air quality. Methods for the detection of short period average and maximum concentrations in the ambient air must be sensitive and accurate in the microchemical or ultramicrochemical range. Other desirable features of a method should include a high degree of specificity, ease of calibration, and minimum interference from other contaminant gases present in the air sample. Of the available methods for sulfur dioxide analysis, those commonly employed in ambient air sampling are conductimetric, titrimetric, colorimetric, turbidimetric, and iodimetric. Procedures for the analysis of sulfuric acid mists and hydrogen sulfide are also indicated. The most sensitive method for the determination of nitrogen dioxide in the atmosphere is based on the Griess-Ilosvay reaction in which a pink-colored dye complex is formed between sulfanilic acid, nitrate ion, and alpha-naphthylamine in an acid medium. A procedure for the determination of nitric oxide is also indicated. Two general methods have been recommended for the determination of oxidants and ozone: one is based on the use of a neutral, buffered potassium iodide solution as absorbent, while the second method involves the absorption of the sample in an alkaline solution of potassium iodide in which the interference due to sulfur dioxide is eliminated by treatment with hydrogen peroxide. In general, methods for the analysis of fluorides in air consist of sample collection, preparation of the sample by evaporation and by ashing to destroy organic matter, and steam distillation with perchloric acid to separate the fluoride from interfering substances, followed by colorimetric estimation by titration or by spectrophotometric procedure. Procedures are also described for the analyses of chlorine and hydrogen chloride, hydrogen cyanide and cyanides, ammonia and ammonium compounds, carbon monoxide, and carbon dioxide. Continuous analysis is discussed.

30958

Monteriolo, S. Cerquiglini and A. Pepe

COMPARATIVE STUDY OF METHODS FOR THE DETERMINATION OF AIRBORNE FLUORIDES. Pure Appl. Chem., 24(4):707-714, 1970. 17 refs. (Presented at the International Symposium on the Chemical Aspects of Air Pollution, Cortina d Ampezzo, Italy, July 9-10, 1969.)

Some methods for the determination of gaseous and particulate fluorine compounds present in the air as pollutants are described and compared. Particulates were collected by means of membrane filters; gaseous compounds were sampled by absorption in alkaline solution. The operation included air and stack sampling, the separation of fluoride from interfering substances, and its final determination. Results obtained for the separation of fluoride by distillation and by other microdiffusion techniques are presented. The application of various methods to the subsequent determination of fluoride are also discussed. Spectrophotometric methods were used for the final quantitative determination of the fluoride content. It is concluded that when an aluminum smelter is involved, the mean amounts of fluoride, collected in a five kilometer area surrounding the plant, are higher than five micrograms, with values as high as 375-500 micrograms for 24 hours of sampling. (Author abstract modified)

31115

Kanto Regional Analysis Panel (Japan)

ANALYSIS METHODS FOR FACTORY EFFLUENTS, MINE WASTE WATER, EXHAUST GAS, ETC. (Kojo haisui, ko haisui, haigasu nado no bunsekiho). Text in Japanese. Ryusan (J. Sulphuric Acid Assoc. (Japan))., 24(3):33-43, March 1971. p. 33-43.

Analytical methods specified in existing laws and regulations as well as those adopted by individual industrial firms were surveyed to determine prefectural criteria for noxious gas emissions and appropriate methods for analyzing exhaust gas. Criteria are given for total sulfides (ground-level density), ammonia, carbon monoxide hydrogen chloride, chlorine, cyanic hydrogen, nitrogen dioxide, hydrogen fluoride, benzene, phosgene, formaldehyde, hydrogen sulfide, toluene, and phenol in Tokyo, Osaka, Kanagawa, Fukuoka, and Saitama. The analytical methods are tabulated according to the compound to be determined. Legal references and measuring ranges are indicated. The methods include the neutralization titration, titration, and barium chloranilide methods for analysis of total sulfides; the iodine titration, electroconductivity, infrared- absorption, and detection tube methods for SO2; the iodine titration, methylene blue absorption photometric, and detection tube methods for H2S; the naphthyl ethylene diamine absorption photometric and phenol sulfonic acid absorption photometric methods for the naphtyl ethylene diamine absorption photometric, continuous analysis (absorption photometry), and detection tube methods for NO2; the thorium nitrate-neothorin titration, and lanthanum-alizarin complexion absorption photometric methods for F compounds; the ortho tolidine absorption photometric detection tube, and continuous annlysis methods for Cl2; the thiocyanic acid mercuric absorption photometric silver nitrate titration, neutralization titration, and electroconductivity methods for HCl.

31712

Durst, Richard A.

ION-SELECTIVE ELECTRODES IN SCIENCE, MEDICINE, AND TECHNOLOGY. Am. Scientist, 59(3):353-361, May/June 1971. 15 refs.

Ion-selective electrodes have wide utility for potentiometric measurements in such areas as pollution monitoring, public health, and biomedical research. About 20 different ion-selective electrodes are commercially available. These are listed according to cations and anions detected and according to membrane type: solid-state, heteorgeneous, or liquid ion exchange. Although these electrodes can be used only for solution studies, i.e., the species of interest must be ionic, systems have been developed for the determination of pollutants in gases. In these systems, provision is made for scrubbing the gases with suitable reagents. The quanity of gas and reagent are measured with flow transmitters, and the resulting concentration of the soluble component is measured in the flow-through cell. Such systems have been used for monitoring sulfide and cyanide, fluoride, and hydrogen chloride produced the pyrolytic decomposition of chlorocarbon polymers.

31827

McLean, W. J. and R. F. Sawyer

CHEMICAL KINETICS IN FREE JET EXPANSIONS. Preprint, Combustion Institute, Western States Section, 20p., 1970. 8 refs. (Presented at the Combustion Institute Western States Section, Spring Meeting, Berkeley, Calif., April 20-21, 1970, Paper WSCI-70-12.)

In molecular beam sampling systems such as mass spectrometry, which use a free jet expansion to expand the sample from high source temperatures and pressures to low temperatures and pressures, the chemical kinetics in the free jet determines the integrity of the sample. In the present study, Sherman s equations which are used to compute the temperature and pressure profiles in the expansion of the chemical kinetic equations for several systems, are integrated over these profiles to determine the amount of quenching a sample will experience. For the molecular hydrogen -- atomic hydrogen

system at a source temperature of 3000 K, the degree of H atom recombination in a free jet expansion from equilibrium conditions was investigated for source pressures from 0.5 to 100 atmospheres and orifice diameters from 0.05 to 2.5 cm. For the molecular hydrogen -- molecular fluorine system at 100 psia source pressure and adiabatic flame temperature, the reaction in a free jet expansion was computed for orifice diameters from 0.05 to 2.5 cm and equivalence ratios of 1.0 and 2.0. (Author summary modified)

32450

Panin, K. P.

SEPARATE DETERMINATION OF INORGANIC FLUORINE GASEOUS COMPOUNDS AND WATER SOLUBLE AEROSOLS IN THE ATMOSPHERE. (Razdel noye opredeleniye neorganicheskikh gazoobraznykh soedinenly ftora i aerozoley, rastvorennykh v vode, v atmosfernom vozdukhe). Text in Russian. Gigiena i Sanit., 36(6):58-61, 1971. 3 refs.

Analyzed air was filtered through a material (acetyl celluloid filter AFA-KhA) on which only aerosols (solid fluorine compounds) were collected. These were subsequently washed off the filter with water of varying temperatures. The gaseous compounds were collected in an absorber. Fluorine ions in both the aerosol and gaseous phase were determined by the reaction with a titanchromatrope reagent. Fluorine compounds, poorly soluble in water, were washed off the filter with hot water. In the testing, 96-99% of fluorine substances soluble in water at room temperature were recovered from the filter. The sensitivity of the method is two micrograms of fluorine ions per five ml of solution. The effect of other ions on the determination was studied.

32476

Fukui, Shozo

METHOD OF MEASUREMENT OF HARMFUL MATTERS IN AIR. (Kuki chu no yugaisei bushitsu no sokutei hoho). Text in Japanese. Bunseki Kiki (Analysis Instr.), 9(8):43-59, Aug. 1971. 1 ref.

Various measurement methods of harmful matter in the atmosphere are examined. The orthotolidine method is described for chlorine determination, but there is no reliable method for a high incidence of pollution by chlorine gas. The neutral iodine potassium method for ozone and oxidants; the atom light absorption method for cadmium; the pyridine pyrazole and palladium quinolinol methods for hydrogen cyanide; the dithizone and atom light absorption methods for mercury; and the diazotation and Saltzman methods for nitrogen oxides are reviewed. The atom light absorption method is generally used for lead and zinc, since it is simple and accurate. Sulfur dioxide is trapped with sodium chloride and mercuric chloride in solution; rosaniline formaldehyde is then added, and the mauve color is determined. Fluorides or hydrofluorine are measured by colorimetry, i.e., the lanter-alizarin complexion method. The 3-methyl-benzo-thiazolon- hydrazone method, which is most sensitive, and the chromotropic method are used to measure formaldehyde. Hydrogen sulfide is determined by the methylene blue method, the molybdenum blue method, and the starch iodine method. The methylene blue method gives a unique reaction and involves less obstruction. A new method for trapping sulfides is examined.

32534

Fujinaga, Taichiro and Mutsuo Koyama

ENVIRONMENTAL POLLUTION ANALYSIS -- ESPECIALLY ON THE BASIC APPROACH TOWARD IT. (Kogai bunseki -- Tokuni sono kangaekata ni tsuite). Text in Japanese. Bunseki Kiki (Analysis Instr.), 9(7):3-9, July 1971. 13 refs.

The basic characteristics of an environmental pollution analysis are discussed to clarify the basic approach required for an analysis that is usually of complex nature. Often organic and inorganic analyses must be performed simultaneously. Moreover, an analysis is more than simply qualitative or quantitative. A qualitative analysis intended simply to detect a polluting element in air or water is often meaningless; very often the toxicity of a particular element depends on its chemical state. Therefore, microanalysis or, more properly, trace analysis is required to detect extremely toxic substances. If possible, pollution should be continuously monitored and analyzed. The most dependable of current measuring devices are, theoretically, those employing ion-selective electrodes. Sampling, pretreatment, and measurement methods, together with measurable range and references, are tabulated for different air pollutants. The methods are as follows: dust (particulates), reflection factor or transmittivity measurement; sediment, gravimetric analysis; precipitation density, X-ray, light-dispersion, and gravimetric. X-ray microprobe analysis, fluorescent X-ray analysis, radiometry, emission spectrochemical analysis, atomic absorption spectrochemical analysis, absorption photometry, polarography, and gas chromatography are used for metals and other noxious elements. For carbon monoxide or carbon dioxide measurements, conductometry, coulometry, visible absorption photometry, and ultraviolet absorption photometry are used. Turbidimetry, coulometry, and conductometry are used for hydrogen sulfide measurements. Coulometric titration and absorption photometry are used for oxidant measurements. Nitrogen dioxide or nitric oxide measurements use visible radiation absorption photometry. Organics are measured by gas chromatography. Ammonia, aldehydes, fluorine, phenyl acetate, mercury, tetraethyl lead and hydrogen cyanide use visible radiation absorption photometry.

32631

Ciferri, R.

ROMELL S REACTION FOR THE RAPID DETECTION OF TOXIC GASES IN THE AIR. (La reazione di Romell per iil saggio rapido di gas tossici nell aria). Text in Italian. Boll. Sta. Patol. Veg. Rome, 21(2):117-122, 1941. 1 ref.

Analysis of the air in the vicinity of two plants suspected of emitting toxic gases revealed that Romells reaction is suitable for the detection of minimal concentrations of hydrofluoric, hydrochloric and sulfurous acid. Identification of these acids can be accomplished either by means of a marginal color change or by the discoloration of a paper filter impregnated with a one percent Delafield hematoxylin solution. According to experimental data, a certain relationship was established between the appearance of the colorimetric reaction and the distance from the emission center. However, the variations of the marginal color changes from one determination to the next did not allow a quantitative determination of the concentrations of the gas in the air. The same was true for the qualitative identification of the particular gas present.

32643

Haroutiounian, E. and H. Bryks

CONTINUOUS CONTROL OF IMPURITIES IN ATMOSPHERES. (Control continu d impuretes dans les atmospheres). Text in French. Technicon Corp., Ardsley, N. Y., Proc. Symp. Automation in Analytical Chemistry, 3rd, New York, 1967, p. 365-370. (Nov. 13-15.)

In processing semi-conductors, continuous control of the purity of the inert gases and atmospheres used is necessary to ensure that constant properties of materials are maintained, since impurities such as hydrogen sulfide, sulfur dioxide, hydrochloric acid, and hydrofluoric acid can greatly damage production. A technique of gas analysis which ensures rapid response, sensitivity, reproducibility, and simultaneous analysis of gas derived from several sampling locations is described that is based on the application of colorimetry to the technique of the Auto-Analyzer Technicon. The apparatus consists of an Auto-Analyzer Technicon which comprises a contact column, proportioning pump, colorimeter, and recorder; an air pump with adjustable output; a multi-channel Technicon programmer; and gas distribution control panel. Impurities are analyzed in nitrogen, air, hydrogen, and furnace atmospheres rich in hydrogen. An operating cycle, comprising the successive determination of an impurity in these gases, takes one hour and is programmed in advance. The lapse between sampling and recording is 20 minutes, ensuring complete development of the colorimetric reaction.

32966

Eggebraaten, V. L. and L. E. Miller

DETECTION OF FREE FLUORINE IN THE ATMOSPHERE BY I(131) RADIOTRACER ANALYSIS. Intern. J. Appl. Rad. Isotop. (London), 18(3):183-191, March 1967. 6 refs.

The chemical displacement reaction, F2 + 2I(-) yields I2 + 2F(-) was evaluated as a means of detecting and measuring free fluorine in the atmosphere. The objectives were to determine the chemical properties of this reaction at micro-concentration levels, to develop the calibration techniques which will produce a working analytical procedure, and to predict the potential service of this system as a compact, portable type instrument for performing atmospheric determinations on field locations. Atmospheric gases were passed through alkali iodide columns tagged with radioactive iodine (131), which is released and captured in a sodium thiosulfate solution upon exposure to calibrated quantities of fluorine contamination. Favorable features of this radio release technique include determination of quantitative amounts of fluorine in ppb quantities, instantaneous recording of the atmospheric contamination, discrimination between elemental and combined fluorine, and instrument portability. The disadvantages of the I(131) system stem from the fact that the isotope must be used in non-occupational areas. (Author introduction modified)

33632

Kubec, Zdenek and Ema Maierova

USE OF SELECTIVE FLUORIDE ELECTRODE IN CONTROLLING THE PRODUCTION OF HYDROGEN FLUORIDE. (Pouziti selektivni fluoridove elektrody pri kontrole vyroby kyseliny fluorovodikove). Text in Czech. Chem. Prumsyl (Prague), 21(46):388-389, 1971. 4 refs.

A procedure is desribed for determining total fluorine in waste calcium sulfate and in the waste gas formed in the production of hydrogen fluoride from a fluorite concentrate. Analysis is based on measuring the potential of a selective electrode (Crytur 09-17) in a suitably treated sample solution. The procedure facilitates control of hydrogen fluoride production. (Author abstract modified)

33711

Kaneda, Kazuko

DETERMINATION BY THE SEPARATION OF GASEOUS AND PARTICULATE FLUORIDE. (Gasu jo oyobi ryushi jo fukkabutsu no bunrisokuteiho). Text in Japanese. Niigata-ken Eisei Kenkyusho Shudankai Shoroku (Niigata Prefect. Public Health Lab. Meet. Abstr.), 1970:14-15, 1970.

Results of fluoride determination as a particulate, using filter paper, and in gaseous form, adsorbed by aluminium, glass spiral, and unglazed tubes, were examined. For collecting particulate fluoride, seven filters millipore were compared; AA had the smallest gas absorption. For the separation of gaseous fluoride, the almost 100% HF gas was collected by the glass spiral tubes. Separation of gaseous and particulate fluoride was effected by passing particulate fluoride through the tube and then collecting the fluoride on alkaline filters. On the assumption that the rate of particulate to total fluorides was 50-70%, when 4 ppb total fluorides were in the air, particulate and gaseous fluorides were separated with millipore and alkaline filters at 20 ml/min and determined by the analysis of ion electrodes.

33929

Bredemann, G. and H. Radeloff

THE DETECTION OF DAMAGE CAUSED BY FLUORINE EXHALATIONS. (Zur Diagnose von Fluor-Rauchschaeden). Text in German. Phytopathol Z., 5(2):195-206, 1933. 19 refs.

Industrial fluorine emission do not disperse as widely as sulfur dioxide emissions; 1 km away from the source no noticeable damage attributable to fluorine could be detected. Since fluorine-induced damage to plants is not characteristic and cannot be detected by botanical inspection, a microchemical analysis is necessary. Two methods are suitable. The Feigl and Krumholz method volatilizes fluorine in the form of silicon fluoride and determines Si in the distillate. The sodium fluosilicate crystal method processes plant substance with silica sand and sulfuric acid. With a sodium acetate solution easily the escaping silicon fluoride forms discernible hexagonal crystals. The natural fluorine content of the plant substance does not interfere with either method or does fluorine-rich soil from fluorine-containing phosphates. Whether fluorine damage undetectable by either method can occur is an unresolved question. If the Na2SiF6 crystal method, which should be applied first in case of fluorine plant damage, does not yield conclusive proof then a somewhat more sensitive method (the molybdatebenzidine color method) should be employed. If the crystal method is negative but the molydate method positive, fluorine damage is considered proven.

34125

Killick, C. M.

THE MEASUREMENT OF ATMOSPHERIC FLUORIDES BY REACTION WITH SELECTED FILTER MATERIALS. Warren Spring Lab., Stevenage (England), Rept. LR 130(AP), 14p., Aug. 1970. 12 refs.

Glass fiber and silver membrane filters were used to absorb gaseous fluoride at atmospheric concentrations. Compared with the standard impinger method, the collection efficiency was below 50% and the absorbed fluoride was hard to remove. The glass fiber filter contained high intrinsic levels of fluoride which could not be removed without destroying the filter. (Author abstract modified)

34126

Bailey, D. L. R., C. M. Killick, and P. E. Trott

STANDARD METHOD FOR SAMPLING AIRBORNE FLUORINE COMPOUNDS. Warren Spring Lab., Stevenage (England), Rept. LR 129(AP), 7p., Sept. 1970. 6 refs.

A standard method for sampling and analyzing fluorine compounds in the atmosphere is presented. The sample is collected by an impinger. The fluoride is then distilled to remove interfering matter and the distillate is analyzed by colorimetry and read on a spectrophotometer. Equipment design and process description are included.

35108

Ministry of Commerce and Industry (Japan), Dept. of Environmental Pollution

MONITORING APPARATUS FOR AIR POLLUTION. (Taiki osen ni kansuru sokutei kiki). Text in Japanese. In: A Survey of Industrial Pollutant Disposal Machines - 1971. p. 178-181, Dec. 1970.

Various air pollutant measuring equipment are reviewed. In the atmosphere, settling particles, suspended particulates, sulfur oxides, and toxic gases such as hydrogen sulfide, nitrogen oxides, hydrogen chloride, and hydrogen fluoride are monitored. Deposit gauges, hi-volume samplers, and the lead dioxide method are explained as methods of measuring suspended particulates. For measurement of pollutants from specific emission sources, Ringelmann s chart is used. According to the Japanese Air Pollution Control Law, dust or soot emission is determined by the weight of particles contained in one cu m of air at air pressure one, and the method of measuring designated by the Japanese Industrial Standard Law is the filter method of collection, using a dust tube filled with glass wool or a filter paper, suspended in flue gas, and weighing the soot. The apparatus for this method comprises a scale, a dust collector, a vacuum pump, and a flowmeter. Sulfur dioxide content in stack gases is calculated from the weight of fuel, and one kg of heavy oil with S % sulfur content is 0.7 S N cu m. A non-dispersion infrared analyzer is used for carbon monoxide, carbon dioxide, hydrocarbons, and sometimes nitric oxide from automobiles. The total bag method, the constant volume sampler method, and Diesel smoke filters are briefly mentioned.

35441

Chovin, P.

ATMOSPHERIC POLLUTION AND ANALYTICAL CHEMISTRY. (Pollution atmospherique et chimie analytique). Bull. Soc. Chim. France, no. 5:2191-2215, 1968. 339 refs. Translated from French. Naval Intelligence Command, Alexandria, Va., 64p., Dec. 15, 1970.

Domestic heating systems, industrial heating plants, and motor vehicles are the three major sources of pollutants. The most important substances emitted are sulfurous gas, hydrogen sulfide, dust, nitrogen oxides, ammonia, fluorine compounds, ozone, peroxyacetyl nitrates, carbon monoxide, hydrocarbons, tars, and aldehydes. Methods for the determination of these compounds are indicated and described.

35737

Hagiwara, Toshiaki

MEASURING APPARATUS FOR TOXIC GASES. (Yudoku gasu no sokutei kiki ni tsuite). Text in Japanese. Nenryo Oyobi Nensho (Fuel and Combustion), 38(12):1217-1220, Dec. 1971.

The principles, mechanism, and characteristics of various toxic gas measurement apparatus and one flue-gas sulfur dioxide analyzer are briefly discussed. One apparatus is specifically for hydrocyanic acid (HCN), hydrogen sulfide (H2S) and chlorine (Cl2) detection. Its principle is the electrochemical reaction between electrolyte and the specific elements in the air. The range of detection is 0-50 ppm for H2S and HCN, and 0-5 ppm for Cl2. The circuit condition is excellent, the battery does not have to be replaced for more than two years, and the electrolyte has to be replenished only once in two weeks or 20 days; it is compact and installation is possible anywhere. The carbon monoxide alarm is often used in a tunnel or an underground parking lot. The sample air is sucked in by a pump and is burned; then the temperature change is detected. The range of detection is 0-500 ppm, the alarm point can be set for less than 50 ppm. It is characterized by compact size and a device which makes the internal installation of an automatic timer possible. The traceable gas ionization analyzer is used mainly for the detection of traceable leakage of such gases as hydrogen chloride, hydrogen fluoride, phosgene, ammonia, and nitrogen dioxide. The mixture of the sample gas and a reagent is led into an ion chamber in an aerosol form, and the decrease of ion current is detected. This analyzer can detect various types of gases by changing the reagent. Depending on the nature of the gas, traceable amounts of ppb order can be detected. There is no danger of effects on human health, and the analyzer may be used without permission.

35956

Cooper, Hal B. H., Jr. and August T. Rossano, Jr.

SOURCE TESTING FOR AIR POLLUTION CONTROL. Wilton, Conn., Environmental Research and Applications, Inc., 1971, 228p. 532 refs.

Source testing for air pollution control is reviewed with respect to basic procedures, terminology, operating and theoretical priciples, gas flow measurements, sampling trains, principles and methodology of particulate sampling, gaseous sampling, continuous monitoring, and special applications of various techniques. Measurements of stack gas parameters prior to sampling are discussed for determinations of temperature, pressure, moisture content, and gas composition using such instruments as thermometers, thermocouples, thermistors, wet or dry bulbs, condensation methods, Orsat analyzers, pitot tubes, anemometers, tracers, balloons, and various meters. Instrumentation for particulate sampling includes sampling probes, flowmeters, wet impingers, filters, centrifugal separators, and electrostatic and thermal precipitators. Particulate sampling trains are examined with respect to specific contaminants (polynuclear hydrocarbons, fluoride compounds, mists, tars, and droplets); combustion sources, e.g., boilers, incinerators, open burning, pulp and paper plants, lime kilns, kraft recovery furnaces, chemical processing, and metallurgical operations; and particle size analysis using impingers and cascade impactors. Sampling techniques for gases containing sulfur oxides, hydrogen sulfide, mercaptans, total sulfur, nitrogen oxides, ammonia, chlorine compounds, carbon monoxide, and organic gases and vapors include absorption into a liquid phase, using sample probes and impingers; collection in fabric bags; adsorption on a solid; and freeze-out techniques. Subsequent analytical methods include wet chemical analysis (turbidimetry, colorimetry, potentiometry, polarography, iodimetric methods, and Orsat analysis) and instrumental analysis (gas chromatography, spectrophotometry, flame ionization, and mass spectrometry). Special applications for the techniques include determination of odor thresholds of flue gases, measurement of acid deposition onto metal surfaces, the presence of radioactive materials, and bacterial emissions to the atmosphere. Pertinent source test data and sources of equipment are included.

36002

Torii, Kenji

AUTOMATED CHEMICAL ANALYSIS OF AIR AND WATER POLLUTION. Preprint, Dept. of Commerce, Washington D. C., and Water Pollution Control Federation, Washington, D. C., 13p., 1971. (Presented at the Technical Conference on New Technology in the Solution of Practical Problems in Air and Water Pollution Control, Tokyo, Japan, Dec. 9, 1971.)

The contribution of automated pollution analysis of impinged samples, continuous single channel systems, and comprehensive mobile laboratories to the study of man s environment is discussed. A typical flow diagram for fluoride in waste water illustrates the use of basic automatic analyzer modules. Water quality assessment and the monitoring of organic wastes in waste water are discussed, as well as the periodic or cumulative sampling of air quality. Recent technical developments in instrumentation and application are presented. However, automated analysis in itself cannot make any contribution to the study of the environment we live in, without the proper personnel utilizing the techniques that are available, and producing meaningful interpretation of the vast amount of data so obtained. (Author conclusions modified)

36125

Bogorad, G. I., A. Ya. Bonn, A. M. Drobiz, I. A. Pushkin, and M. K. Yarmak

IONIZATION METHODS OF MONITORING AIR POLLUTION. Zh. Vses. Khim. Obshchestva im. D. I. Mendeleeva, 15(5):514-519, Oct. 9, 1970. 38 refs. Translated from Russian in: Atmospheric Studies at Chemical Enterprises - USSR, p. 68-80, March 9, 1971. Joint Publications Research Service, Washington, D. C. NTIS: JPRS-52566

Aerosol-ionization and flame-ionization detectors for monitoring microadmixtures in air are discussed. Aerosol-ionization detectors have high sensivity, low inertia, and the possibility of selective control of a broad class of gas components. The essence of aerosol ionization is the fact that the controlled component of the gas mixture is selective and converts quantitatively into the aerosol state. The aerosol particles formed are detected in the ionization chamber with a radioactive ionization source. American-made aerosol-ionization instruments measure from approximately 0.01 to 10 mg/cu m of hydrogen fluoride, prussic acid vapor, phosgene, and tetraethyl lead present in the air of industrial facilities. Stationary and portable versions of the analyzers are available. Soviet aerosol-ionization detectors provide for the continuous monitoring of nitrogen oxides (0-10 mg/cu m). In contrast to aerosol-ionization detection, flame-ionization detection is specific only for organic substances. The detectors operate on the principle of ionization of molecules in the organic substances in the hydrogen flame and subsequent measurement of the magnitude of the ionization current. As gas analyzer sensors, they are used without chromatographic columns. Advantages of using the detectors for analyzing organic admixtures on air are their simplicity, absence of sorption storage for controlled microadmixtures, and sensitivites of 0.01 to 0.001 mg/cu m.

36693

MONITOR GRID: PHOSPHATE PLANT S POUND OF POLLUTION PREVENTION. Chem. Week, 1956:60-61, Dec. 1, 1956.

A five-year study of air and water pollution is being conducted in the area where a triple superphosphate plant will be constructed. The purposes of the study, based on data collected by automatic sampling equipment at a series of monitoring stations, are to determine air and water pollution levels before the new plant begins operations and to check on performance of the control equipment being built into the plant. A weather station measures micrometeorologic parameters at ground level and 300- and 600-ft altitudes. At four air sampling stations, analyses are made for fluorides, sulfur dioxide, and sulfuric acid mist; particulate analyses are made monthly from samples collected at eight dust fall stations. Plant indicators will also be used. In-plant pollution control equipment is briefly described.

36771

Eolyan, S. L. and S. G. Eramyan

EXCITABILITY CHANGES OF THE OLFACTORY ANALYZER DURING THE ACTION OF CERTAIN INDUSTRIAL TOXIC SUBSTANCES. (Ob izmenenii vozbudimosti obonyatelnogo analizatora pri vozdeystvii nekotorykh prolzvodstvennykh khimicheskikh veshchestv). Text in Russian. Vestn. Otorinolaringol (Moscow), vol. 22:40-43, Nov.-Dec. 1960. 4 refs.

The excitability of the olfactory analyzer was studied by the Elsberg-Levi olfactometric method in workers having contact with lead (224 persons), fluorine (414), and cyanate compounds (164). Excitability decreased to a larger extent in intoxication with fluorine and cyanides than with lead. Olfactometry may facilitate the detection of early signs of chronic lead action and disclose the initial changes in the nasal mucosa during the action of fluorine and cyanides.

36800

DEPARTMENT IV. Schriftenreihe Landesanstalt Immissions und Bodennutzungsschutz Landes Nordrhein-Westfalen (Essen), no. 21:27-39, 1970 (?). Translated from German. Leo Kanner Assoc., Redwood City, Calif., 26p., March 1971.

In addition to projects designed to determine and evaluate the effects of emissions on plants, emphasis has been placed on studies designed to derive air quality criteria as the basis for establishing emission limits as well as experiments on the resistance of plant species which are important to the economy and to public health. Phytotoxic hydrogen fluoride concentrations were determined, as well as fluorine enrichment in plant organs as a function of exposure height and wind speed. Using the results of fumigation and field experiments, a detection method of sulfur dioxide effects on plants was worked out. Transplanted lichens, grass cultures, leaf-pigment analysis, the inhibiting action of fluorine ions on enzymes, and other indicators of air pollution are discussed. A new method which utilizes an ion specific electrode for the quantitative determination of fluorine levels in plants is described.

37350

Buck, M. and G. Reusmann

A NEW SEMI-AUTOMATIC METHOD FOR FLUORIDE DETERMINATION IN PLANT AND AIR SAMPLES. Fluoride, 4(1):5-15, Jan. 1971. 4 refs. (Presented at the International Society of Fluoride Research Conference, Annual, 3rd, Vienna, Austria, March 22-25, 1970.)

A fluorine-specific electrode permits the electrometric (potentiometric) determination of fluorine in plants and air. An automated system incorporating the electrode and covering all stages of plant analysis from sample preparation to fluorine estimation and printout is schematically illustrated and described in detail. The standard deviation of the automated

electrometric method is approximately 3% and significantly lower than that of the conventional photometric procedure. The automated system permits the number of analyses to be doubled compared with the manual electrometric procedure and, since the distillation stage is omitted, tripled in comparison with the photometric precedure. Substances other than F(-) do not interfere with the electrometric method. In the case of air samples containing nonsoluble F(-) compounds, the method yields lower values than photometric methods. It is, therefore, used to analyze the phytotoxic portion of F(-) compounds in air.

37463

Mori, Masaki, Shonosuke Ito, Hiroshi Ogino, and Hiroyoshi Morita

FLUORIDE ANALYZER IN STACK GAS. (Konodo fukkabutsu jido kirokukei). Text in Japanese. Taiki Osen Kenkyu (J. Japan Soc. Air Pollution), 6(1):99, 1971. (Presented at the National Council Meeting of Air Pollution Studies, 12th, Nagoya, Japan, Oct. 27-29, 1971.)

An instrument to determine hydrogen fluoride in stack gas up to 2.0 ppm was developed. Sample gas flows at 10 l/min through a filter into the absorption section where it contacts with a buffer solution with a pH of approximately 5.5, which is fed there at 1 ml/min. The buffer solution absorbs the HF and is led into a measuring cell, where the concentration of the gas is determined by means of a fluoride ion electrode and a comparative electrode. The scale of a recorder is made linear to the gas concentration through inverse logarithm amplifier. The response time to 90% indication is approximately 2 min for about 1.5 ppm HF.

37515

Okita, Toshiichi, Hiroshi Ogino, Masaki Mori, and Jinkichi Miyai

AN ATMOSPHERIC HYDROGEN FLUORIDE RECORDER ON THE FLUORIDE ION ELECTRODE. (Taikichu fukka suiso jido kirokukei - Fusso ion denkyoku ni tsuite). Text in Japanese. Taiki Osen Kenkyu (J. Japan Soc. Air Pollution), 6(1):98, 1971. (Presented at the National Council Meeting of Air Pollution Studies, 12th, Nagoya, Japan, Oct. 27-29, 1971.)

The characteristics of the electrode potential of the fluoride ion electrode, which is a probe for an atmospheric hydrogen fluoride recorder, was examined. With an increase in the concentration of the pH buffer solution, which is used to buffer the effect of sodium carbonate collecting hydrogen fluoride, the potential tends to be more stable, although its response becomes slower. When the ion strength is increased by the addition of sodium chloride, more stable potential and more rapid response are obtained. Carbonate ion of sodium carbonate does not interfere with the measurement. Ethyl alcohol is recommended for cleaning the electrode, the performance of which has deteriorated during its use.

37579

Liberti, A. and M. Mascini

DETERMINATION OF FLUORIDES IN POLLUTED AIR BY USE OF AN ION SPECIFIC ELECTRODE. Fluoride, 4(2):49-56, April 1971. 11 refs. (Presented at the International Society of Fluoride Research Conference, Annual, 3rd, Vienna, Austria, March 22-24, 1970.)

A membrane electrode specific for the fluoride ion greatly simplifies the analytical determination of fluoride in a variety of samples, including polluted air and stack effluents. The main advantage of the electrode is the elimination of time-consuming distillation procedures for the separation of fluoride: determination is by direct potentiometry or, preferably, by potentiometric titration. Total fluoride, gaseous and particulate, in ambient air or stack gases, is sampled by drawing air through a membrane filter impregnated with sodium formate. The collected material is dissolved in water. Depending on the volume of air and the extent of pollution, a fluoride concentration of 0.1-5 ppm is obtained. In this range, the electrode yields a linear response proportional to the fluoride activity. With respect to the total fluoride concentration, the direct potentiometric measurement is subject to interference of other ions affecting fluoride activity. The accuracy of determination is greatly increased by potentiometric titration in a sodium fluoride solution and by plotting the experimental values with the Gran function. Stack gases can be continuously monitored by this method.

37799

Kasparov, A. A. and V. G. Kiriy

ON THE METHODS OF DETERMINING BORON FLUORIDE IN THE AIR. (K. voprosu o metodakh opredeleniya ftoristogo bora v vozdukhe). Text in Russian. Gigiena i Sanit., 37(1):57-59, 1972. 4 refs.

An improved method for the determination of boron fluoride in low concentrations in the air, applied in sanitary paxis, is described. The method is based on the hydrolysis of BF3. The determination is made on the basis of boron ions following the distillation of the fluorine, by means of 1,1-diantrimide indicator. The necessary reagents are 98% sulfuric acid, an indicator solution with sulfuric acid, while the standard solution of boric acid contains boron in a concentration of 1 mg/ml. The sampling is made by two absorbers containing distilled water. The flow rate applied is 60 l/hr at a sample volume of 30-60 l. The fluorine distillation is made by means of sulfuric acid of 98% in oil bath of 140-150 C. About half of the liquid should be evaporated, while the fluorine forms volatile fluosilicic acid with silicon in the presence of sulfuric acid as a catalyst. The boric acid losses are unimportant. The analysis is made by means of 98% sulfuric acid and indicator After heating in boiling water bath and cooling down, the determination is made by comparison with a standard or by the colorimetric method, using red filter. The calibration curve is plotted from standard solutions with different concentrations. The test with distilled water showed good accordance of the results. The sensitivity is 0.2-0.3 micrograms of boron or 1.5-2.0 micrograms of BF3, with a maximum error of 5-10%.

38278

Scholl, G. and H. Rudolph

AN EXPOSURE APPARATUS FOR HIGHER PLANTS FOR BIOLOGICAL INDICATION OF AIR POLLUTION. (Ein Expositionsgefaess fuer hoehere Pflanzen zur biologischen Indikation von Luftverunreinigung). Text in German. Wasser Luft Betrieb, 16(3):96-97, March 1972. 6 refs.

The exposure equipment for measuring fluorine emissions comprises a container resting on a pole. The container is made of plastics and is composed of a supporting container and a plant cultivation container. In the bottom of the outer supporting container, two borings provide for air circulation and water outflow. The container is screwed to the pole, an iron tube. The supporting container has a latex coating to reflect solar radiation. The plant cultivation container consists of a lower chamber holding about 3000 ml water for the water supply of the grass culture. The upper chamber holds the growth substrate and a ceramic cylinder for automatic irrigation. The two chambers are separated by a perforated palate. Excess water

which collects in the substrate can pass through this plate into the water supply chamber, and from there to the supporting chamber where it runs off through the boring. The size and shape of the exposure set-up should not be too large so that a simple iron rod, which is driven 60 to 80 cm into the soil, is a sufficient support.

38280

Schaefer, K.

UNITS FOR MONITORING WATER AND AIR- THE AUTOMATICC ANALYZER. (Geraete zur Ueberwachung von Wasser und Luft - die Kontinuierliche Durchflussanalyse). Text in German. Preprint, 6p., 1972. (Presented at the Fachtagung Umwelt (Verschmutzung, Frankfurt/Main, West Germany, March 21-24, 1972.)

An autoanalyzer is described which can be used in the field of air pollution for determining sulfur dioxide, nitrogen dioxide, nitric oxide, aldehydes, hydrogen sulfide, fluoride, chloride, ammonia, and hydrochloric acid. It can be used in the field of water pollution to determine ammonia, the C.O.D., chromium, copper, cyanide, fluoride, water hardness, nitrite and nitrate, silicates, sulfate and total inorganic phosphate. Autoanalyzers perform all steps of the manual method from sampling to data recording fully automatically, including pipetting, heating-up, and measuring. Manual analysis starts with pipetting, which is performed by the autoanalyzer by the sampler and the pump. If the manual analysis requires filtration, this can be carried out by the autoanalyzer by means of a continuously-operating filter or it can be replaced by dialysis. The entire system of the autoanalyzer is composed of individual components which permit rapid adjustment and provide highest flexibility. Several components in a waste gas flow can be determined simultaneously by dividing the sample flow.

38670

Kanagawa Prefecture, Yokohama (Japan), Public Nuisance Prevention Center

ANALYSIS METHODS APPLIED TO POLLUTANTS. (Kogai kankei no bunsekiho to kaisetsu). Text in Japanese. 122p., Feb. 1972.

Various methods of analyzing heavy metals in the air, stack gases, water, and soil are reviewed. With regard to stack gas tests, atomic absorption spectrophotometry is explained for measuring cadmium, lead, and chromium. For measuring chlorine, the use of orthotolidine as a reagent is discussed. For analyses of fluorine, hydrogen fluoride, and other fluorides, lanthanum-alizarin complex ion method is discussed. For analyses of hydrogen and other cyanides, the pyridine-pyrazolone method and iron electrode method are discussed. The rosaniline test is explained for measuring sulfur dioxide and for detecting sulfur oxides in general the neutralization method, arsenazo III method, and chloranil acid barium test are discussed. The naphthylethylenediamine method is explained for the analyses of nitrogen oxides and nitrogen dioxide. For hydrogen sulfide, the methylene blue method, and for ammonia, the indophenol method and Nestler method are discussed. Gas chromatography is used for analysis of benzenes, toluenes, xylenes, trichloroethylene, phenols, mercaptans, monosulfides, disulfides, and aliphatic acid amines. For measuring formaldehydes, the chromotrope acid method and acetylacetone method are used. The tetra-aminoantipyrine method is also used for phenol measurement, and the p-aminodimethylanilyn method is used for mercaptans. For measuring aliphatic amines, picric acid may also be used.

38741

Hermann, Peter

MEASUREMENT OF GASEOUS FLUORINE COMPOUNDS IN THE OUTDOOR AIR AND IN INDUSTRIAL WASTE GASES. (Messung gasfoermiger Fluorverbindungen in der Aussenluft und in Industrieabgasen). Text in German. Tech. Ueberwach. (Duesseldorf), 13(2):42-45, Feb. 1972. 29 refs.

For the measurement of fluorine emissions, the dual paper tape sampler and the bicarbonate coated tube were developed in the U. S. In West Germany, the sorption method has been developed in which the gaseous fluorine compounds are absorbed on a thin sodium carbonate layer which covers silver balls. These balls are in a quartz tube. For separation of the coarse dust a synthetic cylinder is attached to the inlet. The air is drawn on at a speed of 0.8 to 1.0 cu m/hr. For the analysis, the alizarine-Komplexon-Method or a fluoride sensitive electrode is used after distillation. For the measurement of fluorine emissions various sampling equipment is available, such as the Rheinfelder apparatus, the apparatus of the National Center for Air Pollution Control, and the apparatus of the Rhine-Westphalian Technical Inspection Association. The Rheinfelder sampler can be used at relatively low waste gas temperatures (100 C) and a sampling speed of 0.4 cu m/hr. The sampling pipe is of stainless steel, the dust is collected on a heated paper filter. For gas absorption special scrubbers of plexi-glass are used. For analysis the photometric detection via the lanthane complex of the AC is mostly used in West Germany. A comparison of this method with the method of thorium nitrate titration revealed no significant differences. In the U. S. the circonium-SPADNS method is frequently used. All these methods require the prior separation of interfering components, such as heavy metal ions, oxidizers, and various anions. A separation of solid and gaseous fluorine compounds can be only approximately achieved.

38905

Haneda, Mikiko and Tsunoda, Fumio

MEASUREMENTS OF AIR POLLUTION BY FLUORIDE BY MEANS OF THE LIME TREATED FILTER PAPER METHOD. (Lime treated filter paper ho ni yoru fukkabutsu no ta talkiosen sokuteiho). Text in Japanese. Kankyo Hoken Report. (Environ. Health Rept.), no. 8:23-30, Jan. 1971. 22 refs.

Measurements were carried out for fluoride within a radius of 5 km from the aluminium factory, which was considered as a source of pollution, using the Lime Treated Filter Paper method reported by Miller, and Adams, and also the followup measurements were taken to prove the usefulness of this method. Paper filter No. 51A was used in the LTP method. The filters were treated with 1% lime suspension and when they were dried, exposure was made. Two or three LTP were placed in the air screen at six spots which were located in the different distances and directions from the source of pollution. The variation coefficient of the values obtained from within the premises of the factory was 22.3%. The variation coefficients of values in the polluted area outside of the factory were 3.8 - 8.9% and the average of them of 8.7%. As for the relationship between the exposure duration of LTP and the accumulated amount of fluorine, decreased amounts were observed on the eighth week. Any correlation was not seen between the values obtained by the LTP method and the fluorine amount in soluble components by the dust fall method.

38917

Yanagisawa, Saburo

ESTIMATION OF FLUORIDES BY MEANS OF LANTHANIUM-ALIZARIN COMPLEXONE METHOD. (Rantan azarin conpurekuson ho ni yoru fukkabutsu no teiryo ho). Text in Japanese. Kankyo Hoken Reporto (Environ. Health Rept.), no. 8:11-13, Jan. 1972.

The lanthanium-alizarin method is a highly sensitive method to analyze fluoride compounds of exhaust gas estimating fluorides according to colorimetric determination. The ALC-La-F substance was extracted by a N, N-diethylanilineisoamylalchol solution, and the degree of extinction was measured by a photometer. Changes were observed in the degree of extinction due to aluminum, copper, iron, and hypophosphate among coexisting cations and anions. Studies were made on the quantity of buffer solution which was added upon extraction, and commotion time. It was possible to elevate the sensitivity of measurement up to 1.4 ppb.

39008

Hermann, Peter

MEASUREMENT OF GASEOUS FLUORINE COMPOUNDS IN THE ENVIRONMENT AIR AND IN INDUSTRIAL WASTE GASES. (Messung gasfoermiger Fluorverbindungen in der Aussenluft und in Industrieabgasen). Text in German. Tech. Ueberwach. (Duesseldorf), 13(2):42-45, Feb. 1972. 29 refs.

Different techniques for the measurement of fluorine compounds are reviewed. Practical emission measurements are made by means of sorption techniques with preliminary separation of coarse particles. The techniques using a sodium bicarbonate-coated tube and dual paper tape sampler have been improved by the Boyce-Thompson Institute (Yonkers, N. Y.) to facilitate the separation of gaseous and particulate fluorine compounds. The analysis can be made by distillation or fluoride-sensitive electrode. Sampling on NaCO3 coating and analysis by the alizarin technique and fluoride-sensitive electrode were carried out. Quartz probes with quartz filters are useful in sampling for emission measurements. Different types of samplers are described. In fluorine ion determination, both the alizarin and thorium titration methods give reliable results. The SPADNS method is preferred in the U. S. When using a fluoride-sensitive electrode, special attention should be given to the aluminum ion concentration. The standard deviation for concentrations of 15-34 mg F/cu m, from combustion processes, lies in a range of plus or minus 0.6-2.8 mg F/cu m. The results of emission measurements are given.

39022

Hildebrandt, P. W.

AIR POLLUTION MONITORING. Hort Science, 5(4):243-244, Aug. 1970.

Techniques for monitoring pollutants in the ambient air and monitoring with relation to effects on vegetation and materials are reviewed. Limits of applicability, efficiency, operating principles and problems reviewed for fluoride sampling using filters and impingers; automated sulfur dioxide analyzers based on colorimetric (West and Gaeke), coulometric, and conductivity methods; colorimetric and coulometric techniques, the potassium iodide method, and SO2 scrubbers for defining oxidant and ozone concentrations; infrared spectrometry for carbon monoxide analysis; high volume samplers and fiberglass filters for measuring suspended particulates; and particle fallout measurements. In addition to measuring the contaminants, effects monitoring using sulfation candles, rubber cracking, indicator plants, visibility measurements, dye and fabric deterioration, and dust fall is often used.

39136

Kanagawa Prefectural Government (Japan), Dept. of Pollution Countermeasures

ANALYTICAL METHOD RELATED TO ENVIRONMENTAL HAZARD. (Kogai kankei no bunsekiho to kaisetsu). Text in Japanese. 122p., Feb. 1972.

Analytical methods which were adopted by the Center of Public Nuisance in Kanagawa Prefecture were explained. The analysis of soil, biological samples, exhaust gases, and metallic components in air were discussed. Items for analysis differed more or less by samples. In drainage, soil, and biological samples, the analysis of lead, cadmium, mercury, copper, zinc, iron, manganese, nickel, fluoride, chromium, arsenic, cyanide, and phenol and measurements of BOD, COD, and pH were discussed. In exhaust gases, the analysis of Cd, Pb, Cr, F, chlorine, CN(-), sulfur dioxide, total sulfur, hydrogen chloride, nitrogen oxides, ammonia, hydrogen sulfide, benzene, toluene, xylene, trichloro-ethylene, phenol, mercaptans, organic sulfides, and amines were discussed. The analysis of metalic components such as Cd, Cu, Pb, Mn, Ni, and Fe in air samples by the atomic absorption method was explained. It was emphasized that the above mentioned methods were adopted based on the experiments. Basic theories of simple methods of analysis were explained for beginners at the end of the report.

39239

Allen, Nelson and N. Howell Furman

DETERMINATION OF FLUORINE BY PRECIPITATION AS TRIPHENYLTIN FLUORI[illegible] J. Am. Chem. Soc., vol. 54:4625-4631, Dec. 1932. 16 refs.

Fluorine determination through quantitative precipitation as triphenyltin fluoride is examined. The method is suitable for small quantities of fluorine (below 0.04 g) but has several disadvantages in that the reagent is uncommon and expensive, is insoluble in water, and is slightly soluble in alcohol. Large amounts of foreign salts may also cause co-precipitation of the reagent and give high results. Advantages include the crystalline form of the precipitate for easy filtering and quick washing, stability, and speed. Experimental procedure and treatment are discussed.

39243

Allen, Nelson and N. Howell Furman

A POTENTIOMETRIC TITRATION METHOD FOR FLUORINE. J. Am. Chem. Soc., vol. 55:90-05, Jan. 1933. 16 refs.

A method for fluorine determination is described involving the precipitation of cerous fluoride through a new application of the ferriferrocyanide electrode. The method gives good results for fluorine concentrations within 0.1-50 mg. Small amounts of foreign salts may be present, but too large amounts mask the equivalence point. Ions which precipitate cerous cerium must be absent. Experimental procedures and results of fluorspar analysis are discussed. (Author summary modified)

39288

Williams, Charles R. and Leslie Silverman

COLLECTION OF FLUORIDE FUMES IN AIR. J. Ind. Hyg. Toxicol., 27(4):115-117, April 1945. 3 refs.

Laboratory and field tests of fluoride fumes in air indicate that these fumes occur as particulate fluorides with very little gaseous hydrogen fluoride. Both types of studies indicate that the filter paper method can be used for the collection of fluoride fumes in air. Whatman No. 44 and Eaton and Dikeman No. 613-21 give efficiencies approaching 100%. The efficiencies of

four papers tested against fluoride fumes is in proportion to their air flow resistance. (Author summary modified)

39516

NOTIFICATION NO. 984. MEASUREMENT METHODS TO BE DETERMINED BY THE GOVERNOR AS SPECIFIED.... (Kokuji). Kanagawa-Ken Koho (Off. Gaz. Kanagawa Prefec.), no. 81:1-12, Nov. 10, 1971. Translated from Japanese. 57p.

Measurement methods for use under the Enforcement Regulations of the Kanagawa Prefecture Environmental Pollution Prevention Ordinance are presented. Atomic absorption photometry is described for the measurement of cadmium and lead compounds. The pyridine- pyrazolene method is described for measurement of cyanogen, as well as an ion-electrode method. A diphenylcarbazide method is outlined for the determination of chromium, and a silver diethyldithiocarbamate method is indicated for arsenic. A reduction vaporization method of atomic absorption photometry is cited for total mercury, and gas chromatography with an electron capture-type detector can be used for measuring mercury alkyl contents. Phenol contents can be determined by a 4-aminoantipyrine method; copper, zinc, iron, and manganese by atomic absorption photometry; and chromium by the diphenylcarbazide method. Nickel can be determined by atomic absorption photometry, and a lanthanum-alizarin method can be used to measure fluorine content.

39719

Keinitz, H.

DEVELOPMENT OF METHODS OF GAS ANALYSIS. Z. Anal. Chem., vol. 192:160-189, 1963. 29 refs. Translated from German by G. A. MacDonald, British Iron and Steel Industry Translation Service. London (England), 36p., Dec. 1970.

The basic chemical reactions used for gas analysis are reviewed with respect to method for detection and determination and sample preparation. Analytical methods for hydrogen, fluorine compounds, hydrogen fluoride, chlorine compounds, hydrogen chloride, oxygen, ozone, hydrogen sulfide, sulfur dioxide, sulfur compounds, nitrogen, ammonia, nitrous oxide, nitric oxide, nitrogen dioxide, phosphorus compounds, arsenic compounds, antimony compounds, carbon monoxide, carbon dioxide, hydrogen cyanide, carbonyl sulfide, silicon compounds, zinc compounds, lead compounds, boron compounds, and hydrocarbons, e.g., paraffins, olefins, acetylenes, formaldehyde, ethers, ketones, mercaptans, methanes, nitrites, and amines include colorimetry, volumetric techniques, iodimetric methods, spectrophotometry, coulmetry, polarographic methods, electrochemical methods, mass and ultraviolet spectrometry, flame ionization detectors, and turbidimetry.

39762

Haut, Hans van

DETECTION OF SOME AIR POLLUTANTS BY MEANS OF KALE (BRASSICA OLERACEA ACEPHALA) AS INDICATOR PLANT. (Nachweis mehrerer Luftverunreinigungskomponenten mit Hilfe von Blattterkohl (Brassica oleracea acephala) als Indikatorpflanze). Text in German. Staub, Reinhaltung Luft, 32(3):109-111, March 1972. 18 refs.

Air pollutants such as fluorine, chloride, sulfur, and lead were determined by means of the kale (Brassica oleracea acephala) used as plant indicator in nine localities in the Ruhr area. The plants, exposed over a succession of years in the periods from early August until mid-November, showed no visible symptoms of damage. Leaf tissue samples were analyzed for all pollutants. The leaf fluorine content, determined by an electrometric method, was slightly to considerably elevated with 12-10 mg/100 g of dry substance, compared with a natural content of 3 mg/100 g. Chloride content, determined by the potentiometric titration method, was up to four times higher than normal. The sulfur determination, carried out according to Stratmann s microanalytic method, revealed a maximum of 1.83% of S, compared with the normal value of 0.97-1.33%. This may be the result of persistent, fairly low sulfur dioxide concentrations. The lead concentrations, determined by an inverse-polarographic method, were highly elevated in all but two cases. A value of 116 ppm in a plant near a highway was measured. Besides the above pollutants, many aromatic hydrocarbons such as benzo(a)pyrene can be identified by means of kale.

39871

Thomas, Moyer D. and James O. Ivie

AUTOMATIC APPARATUS FOR THE DETERMINATION OF SMALL CONCENTRATIONS OF SULFUR DIOXIDE AND OTHER CONTAMINANTS IN THE ATMOSPHERE. Interdepartmental Committee on Air Pollution, Washington, D. C., Air Pollut., Proc. U. S. Tech. Conf., Washington, D. C., 1950. p. 567-569. 10 refs. (May 3-5, Louis C. McCabe, ed.)

Automotic and portable apparatus for the determination of small concentrations of sulfur dioxide, other gases, and aerosols in the atmosphere are critically reviewed. Each type of apparatus has advantages and disadvantages for particular purposes. The accumulation SO2 analyzers are useful when 30-minute average concentrations are adequate, though short time fluctuations can be approximated. The instantaneous-type sulfur dioxide analyzers show the short time fluctuations more clearly but require an accumulating feature for ease in summarizing the recording. Modifications of the apparatus for determination of hydrogen sulfid and other sulfur compounds of organic chlorine compounds are suggested. Hydrofluoric acid can be measured. An automotic sulfuric acid aerosol analyzer is described. The performance of portable apparatus for determining sulfur dioxide and aerosols is compared with that of the automatic analyzers. Continuous recordin is essential to a complete picture of atmospheric contamination at any location. (Author summary modified)

40138

Tsunoda, Fumio

WET COLLECTOR DETERMINATION OF WATER SOLUBLE FLUORIDE IN THE AIR BY THE ALIZARIN COMPLEXON EXTRACTION ABSORBANCE METHOD. (Arizarin Komporekuson chushutsu kyukodoho ni yoru Taiki chu Sulyosei Fukka butsu no Shishiki hoshu sokuteiho). Text in Japanese. Kankyo Hoken Reporto (Environ. Health Rept.), no. 8:31-32, Jan. 1972. 1 ref.

The air was sampled by a regular air collector and after a test material absorption fluid in the sampling tube was filtrated, the alizarin complexon mixed solution was added to it to give a blue-purple color. Then, N, N-diethylaniline-isoamylalchol solution was added, and it was shaken and left to separate into two layers. The aqueous solution layer was thrown away. Next, to remove the turbidity in the remaining organic layer, the solution of acetic sodium trihydrate salt and glacial acetic acid in pure water was poured, stirred, and left to separate into two more layers. Again the aqueous solution layer was thrown away. The remaining organic layer was taken into a 10 mm cell and the absorbance was measured by comparison with a blank obtained through the same treatment without adding fluorine. Based upon the fluorine standard solution, a calibra-

tion curve was made by measuring the absorbance. The amount of fluorine was found with this curve, and the concentration of fluorine was calculated in the air. The quantitative analysis can be made on up to 0.5 millimicron of F in a test material solution of 30 ml.

40211

Brown, Harry

A NEW INSTRUMENT TO READ GASEOUS FLUORIDE IN AMBIENT AIR DOWN TO FRACTIONS OF A MICROGRAM CU M. Instr. Metals. Ind., vol. 21, 4p., 1971.

A new instrument designed to measure the amount of gaseous fluoride which may escape into the atmosphere from phosphate fertilizer plants, aluminum smelters, and certain incineration, brick, chemical, and glass works, is described. The absorber assembly or carousel consists of three glass tubes in a rotating assembly; these align to steer the airflow or solutions through the correct tube. One tube is in the air stream, and collects the fluoride gas from the air drawn through it by a vacuum pump from the atmosphere. The intake tube feeding into this sampling tube is heated to prevent condensation, which would result in dust buildup causing erratic fluoride readings. Once a sample has been collected, the three-tube assembly rotates, bringing the next tube to the air sampling position and placing the tube with the current sample in a position to be washed by a measured amount of colorimetric solution supplied by bellows pump. This solution, containing the sample, is mixed and passed to a photometer for measurement. The MK II design allows unattended operation for long periods (over 1 wk) and produces a faithful record of the ambient air level measurements of this pollutant down to .02 microgram/cu m. A new monitoring approach is suggested using the MK II Satellite Sensing Unit, where fluoride levels about the perimeter of an industrial site can be measured, to construct Isofluons on an area map.

40409

Okita, Toshikazu

MEASUREMENT OF HYDROGEN FLUORIDE USING FILTER METHOD AND SEPARATE DETERMINATION OF GASEOUS AND PARTICULATE FLUORIDES. (Filta ho ni yoru fukkasuiso sokuteiho oyobi gasujo oyobi ryushijo fukkabutsu no bunri sokuteiho). Text in Japanese. Kankyo Hoken Reporto (Environ. Health Rept.) no. 8:19-22, Jan. 1972.

For efficient collecting and separating of gaseous and particulate hydrogen fluoride, the method using alkaline filters prepared with sodium carbonate and potassium carbonate was described. Filters prepared with 1% alkaline solution have little effect on the absorbance of the alizarin complexon method and give a good collecting yield. Hydrogen fluoride is produced using various dilutions of hydrofluoric acid under 0-5 C and 20-30 C, and also using permeation tube of HF under 3-5 C and 20-30 C. Concentrations of HF obtained by both ways is 0.05-1.0 ppm. As a determination of particulate fluoride compounds, the milipore filter AA is the best for the efficient collecting and filtering nearly 100% of hydrogen fluoride. A milipore AA filter which is 50 mm in diameter and an alkaline treated filter are connected setting the flow volume at 20-30 l/min. Particulate fluoride compounds and gaseous hydrogen fluoride are measurable by this method at the sensitivity of 1 microgram/cu m and 1 ppb/2 hr. Either the Alphson method or fluoride electrode method are applicable for analysis. The temperature and humidity are independent of the collecting yield. The concentrations of fluoride compounds in the atmosphere were determined in the area of an aluminium refinery in Niigata City using alkaline filter method.

40422

DeMaio, Larry

CALIBRATING TRACE GAS ANALYZERS WITH PERMEATION TUBES. Instrum. Technol., 19(5):37-41, May 1972. 8 refs.

The permeation tube method for preparation of reliable, known, low concentration gas mixes has advantages over dynamic and static gas blenders. No expensive or complicated equipment is needed and accuracy is equal to or exceeds other methods. It can be considered a primary standard since it is based on weight loss per unit time. Fluorinated ethylene propylene copolymer teflon tubing was filled with n-butane and sealed with steel balls. Assuming a pickup air-flow rate of 1 to 2 cfm and room temperature, typical values of tubing length are 25 cm for 3 ppm and 225 cm for 27 ppm, permeation rates are invariable for a particular lot of tubing. Such tubes have been used successfully for anhydrous ammonia, nitrogen dioxide, anhydrous hydrogen fluoride, phosgene, hydrogen sulfide, and sulfur dioxide. Calibration takes only 4 hours. Tube life is approximately 6 mos.

40705

Desbaumes, Paul, Eric Desbaumes, and Claude Imhoff

USE OF A FLUIDIZED SILICAGEL POWDER BED ABSORBER FOR THE MEASUREMENT OF FLUORINE EMISSIONS AND IMMISSIONS. (Emploi d un absorbeur a lit fluidise de poudre de gel de silice pour la mesure des emissions et immissions de fluor). Text in French. Pollut. Atmos. (Paris), 14(53):56-61, Jan.-March 1972. 6 refs.

A portable fluidized silicagel powder bed absorber, developed for the sampling of fluorine emissions, was tested in an artificial atmosphere and in an aluminum plant area, and compared to conventional alkaline absorbers. The silicagel powder was impregnated with 3% alcoholic solution of triethanolamine, and then dried at 100 C. The sampling rate applied was 2 l/min. A comparative test of three different techniques for the extraction of the fluoride from the silicagel (maceration, maceration with simultaneous agitation, and elution) revealed the superiority of the latter method which had a maximum efficiency of 99%, depending on the amount of hot water used. Tests with different hydrofluoric acid concentrations revealed a slight decrease (below 99%) in the absorbing capacity of the fluidized silicagel bed absorber for concentrations exceeding 5 mg of F/cu m. The fluorine determination in samples from an aluminum plant area was made by means of the Belcher-West-Sulzberger method, using alizarine complexion and a sodium hydroxide solution as standard solutions.

41020

Gutsche, B. and R. Herrmann

SIMPLIFIED FLUORINE-SPECIFIC DETECTOR FOR GAS CHROMATOGRAPHY. (Vereinfachter fluorspezifischer Detektor fuer die Gas- Chromatographie). Text in German. Z. Anal. Chem., 259(2):126-127, April 1972. 3 refs.

A fluorine-specific flame detector described earlier was simplified by using an interference filter for the wavelength 529 nm. The detection limit was improved through this measure on the average by a factor of 1.58. Experiments with chlorine showed that the detection limit could be improved by a factor of four. The operating principle of the detector is based on the enrichment of an argon flow with metallic calcium vapor which is passed to a hot flame together with the gas chromatographic fraction.

41063

Gutsche, B., R. Herrmann, and K. Ruediger

A FLUORINE-SPECIFIC DETECTOR FOR GAS CHROMATOGRAPHY. (Ein fluorspezifischer Detektor fuer die Gas-Chromatographie). Text in German. Z. Anal. Chem., 258(4):273-277, 1972. 7 refs.

A detector is described in which a stream of metallic calcium in argon is brought into a small acetylene-oxygen flame. If fluorine compounds are added, calcium fluoride bands are observed in the flame. These can be employed for qualitative and quantitative analysis of fluorine in gas chromatographic fractions. The standard deviation was plus or minus 2.7% for flame spectrometric indication and plus or minus 2% for gas chromatographic indication. Possibilities for further development of this method are discussed.

41064

Boyev, I. Ya., Ye. G. Levkov, V. A. Limanskiy, V. P. Bugayev, and A. S. Levkova

SAMPLING, SEPARATION AND FLUORINE DETERMINATION TECHNIQUES IN ALUMINUM MANUFACTURING PLANT-PRODUCED ELECTROLYSIS DUSTS. (Metodika otbora prob, otdeleniya i opredeleniya ftora v elektrolizuykh pylyakh alyuminiyevogo proizvodstva). Text in Russian. Zavodsk. Lab. (Moscow), 38(3):278-281, 1972. 3 refs.

Various filter materials were tested and optimum conditions of fluorine separation and determination were determined. The dust samples were collected with a 0.074-micron filter made of carbon fibers. The retention for finely dispersed dust was above 99%. Preliminary extraction of hydrocarbons by benzene or trichloroethylene was followed by high-efficiency hydropyrolytic separation in the presence of vanadium pentoxide as catalyst. The optimum conditions for the above procedure were a maximum temperature of 1100 C in the reaction zone, 95 C in the steam generator, a vapor-air mixture flow rate of 1.2 l/min, a dust sample-to-catalyst ratio of 1:1, and a reaction time of 60 min. The hydrogen compounds of fluorine that were obtained were absorbed in a basic solution. A current measurement method, based on the Zirconium substitution of iron ions in their fluoride complexes, was used for analysis. Titration with zirconium oxichloride was made after hydrochloric acid was added. The recording of the equivalent points provided high accuracy. A platinum electrode and saturated calomel were applied as reference electrode.

41489

Bartle, E. R., S. Kaye, and E. A. Meckstroth

AN IN-SITU MONITOR FOR HCL AND HF. Preprint, American Chemical Society, Washington, D. C.; American Inst. of Aeronautics and Astronautics, New York; Environmental Protection Agency, Washington, D. C; Inst. of Electrical and Electronics Engineers, New York; Instrument Society of America, New York, N. Y.; National Aeronautics and Space Administration; and National Oceanic and Atmospheric Administration, 7p., 1971. 12 refs. (Presented at the Joint Conference on Sensing of Environmental Pollutants, Palo Alto, Calif., Nov. 8-10, 1971, Paper AIAA 71-1049.)

A modified nondispersive infrared technique, gas filter correlation (GFC) was established as a sensitive and specific means of measuring pollutant concentrations in the presence of interfering gases. The basic idea of GFC is that a pollutant gas matching the spectral characteristics of the pollutant to be detected can be used in a reference cell and thus provide high specificity. A theoretical analysis of the GFC technique is presented. Experimental results given demonstrate that the technique can be used to measure hydrogen chloride and hydrogen fluoride concentrations of less than 0.1 ppm. (Author abstract modified)

41491

Feldstein, M. and D. A. Levaggi

THE DETERMINATION OF ATMOSPHERIC FLUORIDE WITH A SPECIFIC ION ELECTRODE. Preprint, American Chemical Society, Washington, D. C.; American Inst. of Aeronautics and Astronautics, New York; Environmental Protection Agency, Washington, D. C.; Inst. of Electrical and Electronics Engineers, New York; Instrument Society of America, New York, N. Y.; National Aeronautics and Space Administration; and National Oceanic and Atmospheric Administration, 4p., 1971. 13 refs. (Presented at the Joint Conference on Sensing of Environmental Pollutants, Palo Alto, Calif., Nov. 8-10, 1971, Paper AIAA 71-1116.)

Lime-coated filter paper can replace the use of indicator plants and proves to be an inexpensive and reliable method for detecting atmospheric fluoride. A large number of exposure sites are necessary to assure accuracy. A fluoride electrode and an expanded pH meter can be used for the rapid measurement of fluoride concentrations down to 0.02 ppm. Normal background concentrations are under 10 micrograms/mo; fluoride sources increase values to as much as 150 micrograms/mo.

41624

Monteriolo, S. Cerquiglini and A. Pepe

COMPARATIVE STUDY OF METHODS FOR THE DETERMINATION OF AIRBORNE FLUORIDES. Pure Appl. Chem., 24(4):707-714, 1970. 17 refs.

Gaseous and particulate fluorides from an aluminum plant were analyzed over a 2-yr period. The sampling, separation, and measuring procedures used in the study are described. Particulate and gaseous emissions were collected separately using a stack sampling technique in which samples are collected on a membrane filter followed by absorption in alkaline solution. The membrane filter was nearly 100% effective in collecting the particulate of the aerosol. Retention of gaseous F could be reduced to 2.4-4.9% when the stack effluent was preheated with a heating chamber which surrounds the filter holder. Preheating also enabled the use of high filtration velocities (250-600 l. gas/hr). After collection, F was separated from interfering substances by steam distillation with sulfuric acid and by microdiffusion. The microdiffusion process was preferred because of decreased operator time and recovery of larger amounts of F. The F concentration was determined by a spectrophotometric method based on decoloration of alizarin-zirconium lake which permits determination of 0.2-20 micrograms with an accuracy of plus or minus 0.06 micrograms for a 10-ml sample. The OCDE method which involves formation of a F- chelate with lanthanumalizarin complexonate was used for comparison. Results obtained by the two methods are in good agreement although the OCDE method has a better sensitivity for smaller concentrations while the alizarin-Zr method has a wider range of application. Since the mean amount of F collected in an area surrounding an Al smelter can be as high as 375-500 micrograms for 24 hr sampling the alizarin-Zr method was preferred for routine determination in the particular case of Al smelting pollution.

41719

Tsuda, Satoru and Akira Yokohata

ANALYSES OF POLLUTANTS AND PROBLEMS. (Osen bushitsu no bunseki to sono mondaiten). Text in Japanese. Bunseki Kiki (Analysis Instr.) 10(5):371-327, May 1972. 7 refs.

Analytical methods for the determination of sulfur oxides, carbon monoxide, chlorine, hydrogen chloride, fluoride, nitrogen oxides, cadmium, and lead are reviewed. Flame photometric detectors for sulfur dioxide analysis were studied. The sample was mixed with oxygen, and then burned with hydrogen flame, and the intensity of the absorbed light of wavelength at 394 millimicron was measured. By this method, the SO2 can be determined as low as the ppb levels. Flame ionization detection for CO and carbon dioxide determination as methane is also considered. The limits for chlorine discharge, hydrogen chloride, and fluoride emissions are set at 30, 80, and 1-20 mg/cu m, respectively; methods for determinations of these pollutants at or below these levels are included. Although no regulations are established for odorous compounds, the list will include ammonia, methyl mercaptan, ethyl mercaptan, dimethyl sulfite, diethyl sulfite, hydrogen sulfite, methyl amine, ethylamine, trimethylamine, butylene, butyric acid, acetone, and acrolein.

41763

Tsuchihira, Kazuyoshi

MEASUREMENT METHODS IN PUBLIC NUISANCE--ESPECIALLY ON MEASUREMENT METHODS PROVIDED BY THE REGULATIONS FOR PUBLIC NUISANCE. (Kogai no sokuteiho--Kogaiho kankeihoreichu no kensaho o chushin ni site) Text in Japanese. Nippon Eiseikensa Gishikai Zasshi (Jap. J. Med. Technol.), 21(5):524-532, May, 1972.

Measurement methods are divided into two types. One for measuring environmental factors and the other for examining man s health. Pollutants are classified into dust, soot, suspended particulate matter, dust fall, sulfur oxides in smoke, sulfur oxides in air, harmful substances such as cadmium and its compounds, bases, hydrogen chloride, fluorine, hydrogen fluoride, silicon fluoride, lead and its compounds, nitrogen oxides, carbon monoxide, lead compounds, nitrogen oxides contained in automobile exhaust gases, oxidants, and 28 special deleterious substances including ammonia, hydrogen sulfide. Measurement methods for each pollutant are discussed based on the Air Pollution Control Law. As for dust fall and special deleterious substances, measurement methods have not been settled. Measurement methods of noise level based on the Noise Regulation Law are stated.

42375

X-RAYS USED IN AIR POLLUTANT DETECTION. (Roentgenstrahlen als Detektive der Luftverschmutzung). Text in German. Technica, 21 (10):909, May 1972.

A Diemens Sequence x-ray Spectrometer with tabulator control is used for the x-ray fluorescence analysis of air pollutants at an air pollution monitoring station in West Germany. This technique, suitable for the detection and quantitative determination of elements with atomic numbers ranging from 9 (fluorine) through 92 (uranium), permits comprehensive test series to be performed automatically in relatively short time. The aerosol samples (precipitation or filter deposits) are irradiated with high- intensity X-rays, and the spectral breakdown of the secondary radiation thus generated is made by means of an analyzer crystal to determine the composition of the sample and the quantitative proportion of certain elements. Automatic evaluation of nine preselected spectral lines is possible, whereas the tabulator control can be extended to a maximum of 36 spectral lines. The data are punched on punch cards for central data processing. Highly sensitive detection methods for sulfur and fluorine have been elaborated.

42926

COMMUNITY AIR SAMPLING. In: Air Pollution Manual. Part I. Evaluation. Detroit, American Industrial Hygiene Assoc., 1960, Chapt. 8, p. 77-94. 78 refs.

Two important factors in measuring the concentration of a pollutant in the atmosphere are the specificity and the sensitivity of the instrumentation available for measurement. Other important factors in sampling are the time period over which each sample is taken, the number and size of samples to be collected, location of sampling stations, and alteration of collected substances during and after collection. Effects of elevation and topography, diurnal variations, and seasonal variations are considered. The choice of instruments to evaluate air pollution levels will vary according to the condition being assessed and the use to be made of the data. Dustfall sampling is described. The sampling of air particulate matter may be accomplished by filter samplers, impingement apparatus, precipitators, and photometric instruments, as well as by other aerosol sampling devices such as the beryllium air monitor and pollen sampling apparatus. Methods of collecting gaseous matter are indicated, including instrumentation for the determination of sulfur dioxide, carbon disulfide, hydrogen sulfide, cyanides, fluorides, nitrogen oxides, ozone and total oxidants, carbon monoxide, and trace organic gases. In any community type sampling program for air pollution evaluation, the meteorology and topography of the area are extremely critical.

42928

CHEMICAL PROCEDURES. In: Air Pollution Manual. Part I. Evaluation. Detroit, American Industrial Hygiene Assoc., 1960, Chapt. 10, p. 111-131. 234 refs.

The analysis of particulate matter collected from the atmosphere involves consideration of aspects other than chemical content; for instance, one of the most important indices followed in air pollution assessment is the atmospheric loading/unit of surface area and/unit of volume. The introduction of new techniques, such as electron microscopy, has made it possible to carry out more searching assessment of the morphology and other physical properties of particulates. Aluminum and aluminum oxide may be determined spectrographically and colorimetrically, while procedures based on the formation of molybdenum blue or reactions with silver diethyldithiocarbamate in pyridine can be used to determine arsenic. Spectrographic, fluorometric, and colorimetric procedures can be used to identify beryllium, while a spectrographic and an electrochromatographic technique are available for boron determinations. Analytical methods are also indicated for the determination of calcium, cadmium, carbon monoxide, chlorine, chromium, fluorine, iron, lead, magnesium, manganese, nickel, the nitrogen oxides, ozone, peroxides, and other oxidants, silicon dioxide and silicates, sulfur dioxide, sulfur trioxide, sulfuric acid, hydrogen sulfide, and zinc. The identification and quantitative determination of organic substances is discussed, with particular reference made to organic acids, aldehydes, amines, hydrocarbons, ketones, phenols, proteins, quinones, and sulfur compounds.

43234

Nusbaum, Henry

A REAGENT FOR THE SIMULTANEOUS MICROSCOPIC DETERMINATION OF QUARTZ AND HALIDES. White Sands Missile Range, N. Mex., Atmospheric Sciences Lab., DA

Task 1VO1450IB53A-13, ECOM-5085, 8p., Oct. 1966. 1 ref. NTIS: AD 644817

A reagent has been discovered whereby the techniques of dispersion staining microscopy and spot testing may be combined to distinguish halite (sodium chloride) from quartz in atmospheric dust samples. The reagent, referred to as the 4BR reagent, is a solution of ethyl salicylate, phenol, 1-bromonaphthalene, and mercurous perchlorate. The preparation of the reagent and its application are discussed. The use of 4BR improves the accuracy and ease of counting quartz particles in samples of atmospheric dust by excluding halite from the count. The reagent obviates polarized light and rotation of the microscope stage in distinguishing halite from quartz. The differentiation of these two minerals by dispersion staining microscopy is a problem with the smaller particles. The simultaneous determination of submicron particles of quartz, halite, other soluble chlorides, fluorides, bromides, iodides, and sulfates may be possible by modifying the composition of the reagent. (Author conclusions modified)

43570

Zurlo, N.

METHODS FOR THE DETERMINATION OF FLUORINE COMPOUNDS IN THE WORKING AND ENVIRONMENTAL ATMOSPHERE OF ALUMINUM REDUCTION PLANTS. Preprint, American Inst. of Mining, Metallurgical and Petroleum Engineers (AIME), New York, N. Y., 15p., 1971. (Presented at the American Institute of Mining, Metallurgical and Petroleum Engineers, Annual Meeting, 100th, New York, Feb. 26-March 4, 1971.)

During electrolytic production of aluminum, gases and dusts may escape into the atmosphere and, of these, dusts of solid fluorine compounds and of its gaseous derivatives are of special interest. Fluorine checks must be performed in the air around the plants, in the area of the work departments, in the urine of the workers, and in plants. Routine methods for accomplishing these analyses use both microdiffusion with sodium hydroxide absorption and colorimetric analysis and an electrode sensitive to fluorine ions. Equipment, calibration, and analytical procedures are described.

43672

Katz, Morris

THE STANDARDIZATION OF METHODS OF SAMPLING AND ANALYSIS. Intern. Clean Air Conf. Proc., England, 1959, p. 147-152. 26 refs.

For purposes of sampling and measurement, air pollution can be classified as particulate matter, gaseous or vapor products, and radioactive compounds. Various sampling and analytical procedures in use and the criteria for the procedures are discussed. Items suggested for international standardization include the definition of terms and units, dustfall, smoke and suspended particulate impurities, sulfur dioxide, nitrogen oxides, ozone or oxidants, hydrocarbons, carbon dioxide and carbon monoxide, aldehydes, and fluorides. Measurement methods for dustfall, suspended impurities, sulfur dioxide, and fluoride are reviewed. The planning of air pollution surveys, selection of sampling sites, choice of instruments and sampling methods, analytical procedures, and the treatment and correlation of data should receive coordinated attention and clarification.

43979

Katz, M.

GAS ANALYSIS. In: Measurement of Air Pollutants. Guide to the Selection of Methods. Geneva, World Health Organization, 1969, Chapt. 4, p. 42-48, 116-123. 282 refs.

Analytical methods that are highly specific for given gaseous compounds are limited to the measurement of intrinsic properties of the molecule, to the formation of unique reaction products or complexing agents, or to the prior removal of interfering substances by precipitation, reaction, distillation, dialysis, or filtration. When such procedures are not available, the analytical techniques and methods of calibration must be rigidly standardized. The overall nature of community air pollution and its sources has an important bearing on the validity of nonspecific analytical data. The most common gaseous pollutants include sulfur dioxide, hydrocarbons, nitrogen oxides, carbon monoxide, ozone, phosphates, chlorine, fluorides, nitrates, and cyanides. In evaluating and selecting methods for gas analysis the paramount parameters include the efficiency of sample collection; the stability of the reagents and reaction products; the ease of calibration; and the degree of simplicity, specificity, sensitivity, reproducibility, and accuracy of the procedure. Automatic monitoring and sampling instruments use three general methods: continuous sampling, batch-type sampling, and dosimetric sampling. The methods may be based on principles of electrolytic conductivity, electrolytic titrimetry, measurement of electrolytic current or potential, colorimetry, turbidimetry, photometry, fluorimetry, and infrared or ultraviolet absorption spectrometry. Operating characteristics are reviewed for spectrometry, gas chromatography, neutron activation analysis, flame ionization detectors, clathrate compounds containing tritium, and neutron activation, have provided new methods for analyzing gases in the atmosphere.

43981

Katz, M.

RAPID METHODS FOR THE IDENTIFICATION AND MEASUREMENT OF AIR POLLUTANTS. In: Measurement of Air Pollutants. Guide to the Selection of Methods. Geneva, World Health Organization, 1969, Chapt. 6, p. 54-59, 116-123. 282 refs.

Indicator tubes and test papers, ring oven methods, and biological indicators are reviewed as rapid methods for the identification and measurement of air pollutants. Indicator-tube methods can detect minute amounts of gas in a short time by means of portable and inexpensive equipment. A pollutant gas causes a change in the color of a reagent packed in the tube; comparison with color standards or measurement of the length of discoloration can be used to determine the concentration of the gas. To achieve quantitative results, a known volume of air must be drawn through the tube at a constant rate; other gases present in the air must be removed. Potential sources of error include variations in tube diameters, temperature variations, and inaccurate estimation of stain length or color intensity. Test-paper methods may be used for qualitative or semi- quantitative measurement of gaseous pollutants; the paper is exposed to the atmosphere for a known time, and the degree of color change is measured by comparison with color standards. The ring oven technique is a convenient method for studying aerosol pollutants; the samples are collected on paper tape and the analyzing steps are conducted directly on the tape placed on the ring oven. This method will detect inorganic ions in nanogram to microgram quantities, and accuracies of 80-90% can be attained by simple visual matching with a series of standard rings. Biological indicators

are useful in detecting low concentrations of toxic gases that are difficult to detect by other simple means. Chemical analyses of leaves or studies of symptoms can aid in assessing the nature and magnitude of many pollutants, including sulfur dioxide, fluorides, chlorine, hydrogen fluoride, ammonia, hydrogen sulfide, photochemical smog, ozone, hydrocarbons, sulfuric acid aerosol, smokes, and metal compounds as particulate matter. Lichens as indicators of pollution in urban areas are also examined.

43985

Katz, M.

NONAUTOMATIC METHODS FOR THE DETERMINATION OF AIR POLLUTANTS. In: Measurement of Air Pollutants. Guide to the Selection of Methods. Geneva, World Health Organization, 1969, Annex 4, p. 67- 99, 116-123. 282 refs.

The basic principles and procedures, sensitivity, apparatus, and reagents for various nonautomatic methods for the determination of particulate and gaseous pollutants in air are reviewed. Substances reported to cause interference are also included. Methods for analysis include spectrophotometry, the MBTH method, the distillation method, colorimetry, the fluorimetric method, spectrographic methods, the indicator tube method, iodine pentoxide method, infrared spectrometry, a microdiffusion method, nephelometric methods, the Saltzman method, turbidimetry, the West and Gaeke method, the conductimetric method, polarography, and the lead peroxide method. The pollutants which may be determined by the specified methods include acrolein, aliphatic aldehydes, ammonia, arsenic, beryllium, cadmium, carbon disulfide, carbon monoxide, chlorine, chromium trioxide and salts of chromic acid, inorganic fluorides, formaldehyde, hydrochloric acid, chlorides, hydrogen cyanide, hydrogen sulfide, lead, manganese, methanol, nitrates, nitric oxide, nitrogen dioxide, oxidants, phenols, particulate sulfates, sulfur dioxide, and sulfuric acid mist.

43986

Katz, M.

AUTOMATIC SAMPLING AND MONITORING INSTRUMENTS. In: Measurement of Air Pollutants. Guide to the Selection of Methods. Geneva, World Health Organization, 1969, Annex 5, p. 100-113, 116-123. 282 refs.

The basic principles, sensitivity, and operating procedures of various automatic instruments for the sampling of air and the monitoring of gaseous contaminants are reviewed. Substances reported to cause interference are also included. The methods include colorimetry, infrared spectrometric methods, potentiometric methods, electrolytic galvanimetric methods, fluorimetry, conductrimetric methods, the potassium iodide method, titrimetric methods, coulometry, ultraviolet spectrometry, photometric methods, and iodimetric methods using impingers and bubblers for sampling. The gaseous contaminants to which these methods are applicable include carbon monoxide, hydrocarbons, hydrogen cyanide, hydrogen sulfide, hydrogen fluoride, nitric oxide, nitrogen dioxide, oxidants, ozone, and sulfur dioxide.

44083

Jahr, Jorgen

A NEW DOUBLE FILTER METHOD FOR THE SEPARATE DETERMINATION OF HYDROGEN FLUORIDE AND DUST-LIKE FLUORIDES IN THE AIR. (Eine neue Doppelfiltermethode zur separaten Bestimmung von Fluorwasserstoff und staubfoermigen Fluoriden in der Luft). Text in German. Staub, Reinhaltung Luft, 32(6):248-252, June 1972. 2 refs.

The method was developed for personal sampling, but is also suitable for other purposes. The air is drawn through two successive filters in one holder. The first filter is untreated, the second impregnated with sodium formiate. Particulate fluorides are collected quantitatively on the first filter, whereas hydrogen fluoride is found on both. By heating for 20 hr at 75 C in the closed filter holder, the HF collected on the untreated filter is transferred quantitatively to the second, impregnated filter. Leaching the two filters separately after the heat treatment allows the determination of the fluoride ion on each filter by the use of a fluoride-ion specific electrode. The suitable range of the method is approximately from 0.4 micrograms F (-) and upwards for the particulate, and between 0.4 micrograms and 5 mg for HF. (Author summary modified)

44174

Fischer, G. and H. Brantner

STUDIES OF THE AIR-POLLUTANTS IN THE GRAZ AREA, 6TH REPORT: INVESTIGATIONS INTO THE CORRELATIONS BETWEEN THE SULFATE CONTENT AND FLUORIDE CONTENT OF THE LEAVES OF FAGUS SILVATICA (COPPER BEECH), AND THEIR SIGNIFICANCE FOR THE DEMARCATION OF EMISSION-AREAS IN LARGE TOWNS. (Studien ueber die Luftverunreinigungen im Raume Graz 6. Mitteilung: Untersuchungen ueber die Korrelativen Beziehungen zwischen dem Sulfat- und Fluorgehalt im Laub von Fagus silvatica L. (Rotbuche) und ihre Bedeutung fuer die Abgrenzung von Immissionsgebieten in Grossstaedten). Text in German. Zentralbl. Bakteriol., Parasitenk., Infektionskr. Hyg., Abt. 1: Orig., Reihe B, 155(5-6):435-444, 1972. 22 refs. Determinations were made of the sulfate ion content of leaf samples of Fagus silvatica L., which had grown in districts characterized by different emission concentrations. The values thus obtained were compared with the fluoride contents determined in parallel thereto. The highest concentrations of ions were found in the densely built-up regions. The fluoride ion content gradually decreased through the less densely built-up suburbs toward the open country, but the sulfate ion values remained unchanged throughout the suburban region, and then fell to normal values in the open country. If the sulfate and fluoride values found in the urban area are compared with those found in the open country, the difference is found to be significant. The calculation of the correlation coefficients for the individual groups showed a relationship that lay in the same direction but was not very close in any instance. The lowest correlation coefficient was obtained from the comparison of the fluoride and sulfate values in the urban area. Thus these two parameters are completely independent of each other. The variation of the fluoride concentration in the foliage closely corresponds to the distribution that has been discovered on the basis of lichen, urine, and sulfur dioxide analyses. Therefore, the determination of fluoride in plant samples is preferred to that of sulfate, for the qualitative determination of the extent of emission area in large cities. (Author abstract modified

44177

Fischer, G. and H. Brantner

STUDIES ON AIR POLLUTION IN THE GRAZ REGION. 5TH REPORT: THE EFFECT OF EMISSION OF FLUORINE ON THE GREEN AREAS OF A LARGE TOWN. -EXPERIMENTAL INVESTIGATIONS ON FAGUS SILVATICA L. (COPPER BEECH). (Studien ueber die Luftverunreinigungen im Raume Graz 5. Mitteilung: Der Einfluss von Fluorimmissionen auf die Gruenflaechen einer Grossstadt.- Experimentelle Untersuchungen an Fagus silvatica L. (Rotbuche)). Text in German. Zentralbl. Bakteriol., Parasitenk., Infektionskr. Hyg., Abt. 1: Orig., Reihe B, 155(5-6):425-434, June 1972. 8 refs.

Leave samples for fluoride determination were taken from Nov. 1 to Dec. 1 of 1969 and 1970. In the entire period little precipitation fell. For the chemical analysis 5 g of dried pulverized leaves were wetted with 20 ml of calcium hydroxide solution, dried again, and ashed. The ash was then mixed with 60 ml of 75% sulfuric acid. After transfer to the distillation apparatus, 5 ml of 5% perchloric acid were added. After distillation, bidistilled water was used for dilution; 5 ml of the diluted substance was mixed with 5 ml buffer. The fluoride concentration was determined by means of an ion specific electrode. The highest fluorine levels were found in the dense city area and the directly adjoining suburban zone. Peak values between 27 and 48 ppm fluoride ions were measured in the dense northern and northwestern sections of the city. An explanation for this can be given by considering the meteorological conditions during the summer months. Winds from south to southeast prevail in this period. All air pollutants from the southern city areas are transported toward the northern and northwestern mountain barriers. In this area there are several large industries which pollute this section of the city. The mountain barrier prevents the dispersion of the polluted air. Pollutants are transported only by thermal buoyancy and on the few days with winds from the west or northwest.

44238

Fuhrmann, Hans

PROBLEMS OF MEASURING EMISSION OF GASES AND THEIR CONCENTRATIONS IN POWER STATIONS AND THEIR SOURROUNDINGS. (Problems der Emissions- und Immissionsmessung von Gaskonzentrationen in Kraftwerken und deren Umgebung). Text in German. GIT (Glas- Instrum.-Tech.) Fachz. Lab., 16(6):729-733, June 1972. 5 refs.

The specific problems of measuring pollutant concentrations at and around thermal power plants and waste incinerators, as well as suitable measuring techniques are described. Power plant stacks of 80-100 m height have an action radius of about 3 km at wind speeds of 3-4 m/sec. Sulfur dioxide, carbon dioxide, and dust concentration recording is required for steam boilers with capacities exceeding 150 tons/hr. Carbon dioxide measurements are usually made by means of infrared absorption techniques. The measurement of the ultraviolet absorption represents a highly selective method for determining SO2 concentrations in a range of 0-2000 ppm, and also conductivity measurements and photometric procedures are suitable for SO2 determination. Waste gases from waste incinerator plants may contain 0.5-3 mg of SO2, 20-100 mg of sulfur trioxide, 0.2-1 g of hydrochloric acid, 0-10 mg of Hydrofluoric acid, 0-1 g of chlorine, 0-100 mg of phosgene, and 0-2 of nitrogen oxides/cu m. The sampling is made at a temperature of 800-1000 C. The sampling for HCl and HF should be made by means of a heated tube, and for SO2, nitrogen dioxide, and nitric oxide by means of a gas cooler and membrane filter. Ion-sensitive electrodes are used for HF and HCl determination, and photometric or conductivity measurement procedures are suitable for the selective determination of chlorine and phosgene. Infrared and untraviolet absorption techniques are used for SO2 and NO2, while SO3 can be determined by means of conductivity measurement or photometry, using isopropanol as the reagent.

44253

Ogihara, T.

MEASURING APPARATUS FOR TOXIC GASES. (Yudoku gasu no sokutei kiki ni tsuite). Text in Japanese. Nenryo Oyobi Nensho (Fuel and Combustion), 38(12):1217-1220, 1971.

Several effective apparatuses for measurements of toxic gases are introduced. The TOXGARD is designed for the detection of hydrogen cyanide, hydrogen sulfide, and chlorine based on the fact that electric current occurs when these components react with an electrolyte. The measurement ranges are 0 to 50 ppm for HCN and H2S, and 0 to 5 ppm for Cl2, and the response is instantaneous. The CO-ALARM, N701 is for the continuous monitoring of carbon monoxide in air. The measurement range is 0 to 500 ppm and the accuracy less than 1 % of FS. The time of response is less than 45 seconds. The BILLION-AIRE is for the detection of trace gas in air or in a process gas flow, especially for Cl2 from 0 to 50 ppm, phosgen from 0 to 50 ppm, hydrogen chloride from 0 to 10 ppm, hydrogen fluoride and ammonia from 0 to 50 ppm, and nitrogen oxides from 0 to 300 ppm. The accuracy is about + or -2% of FS, and time of response is 10 seconds. Detectors for combustible gases for preventing explosions and for sulfur dioxide are also mentioned.

44285

ENVIRONMENTAL MONITORING GOES AUTOMATIC. Mod. Power Eng., 66(6):62-63, June 1972.

Automatic monitoring of air quality on municipal and national levels and its advantages for predicting future pollutant concentration levels are discussed. Modern monitoring systems can provide remote, unattended monitoring of air and water quality, gather meteorological data, and give alarms or immediate on-line transmission of data to a central point to allow prompt corrective action to be taken. A typical installation monitors meteorological data. Automatic sampling and monitoring instruments are available for parameters concerning typical air quality measurements including: sulfur dioxide, nitrogen oxides, particulate matter, hydrocarbons, chlorine, fluoride, ozone, and mercury. The city of Toronto, Canada is duplicated in a mathematical model used by the air quality branch of Environment Ontario to demonstrate and predict the relationships between various air quality factors in the city. There is also the nucleus of a central environmental monitoring system operating on a national basis. The national air quality surveillance system brings together data collected form air monitoring stations across Canada for computer analysis and comparison. Operations of this system are presently limited largely to analysis and reporting of data. If emissions of all plants could be measured on a minute-by-minute basis by the appropriate pollution control authorities, there could be no better protection against uninformed and biased attacks by environmental groups and environment quality control agencies.

44552

Ito, A., M. Taido, and M. Suzuki

STUDIES ON HYGIENIC CHEMISTRY OF AIR-POLLUTANTS (1). MEASUREMENT OF FLUORIDES IN THE AIR. (Taiki osen busshitsu no eisei kagaku ni kansuru kenyu (1): taikichu no fukkabutsu no sokutei ni tsuite). Text in Japanese. Taiki Osen Kenkyu (J. Japan Soc. Air Pollution), 4(1):112, 1969. (Presented at the Japan Society of Air Pollution, Annual Meeting, 10th, Tokyo, Japan, 1969, Paper 111.)

The effects of types and concentration of absorbent for gaseous fluorides (usually dilute sodium hydroxide) on absorption speeds and quantity of fluoride absorption were examined. Coexisting ions in the atmosphere act as obstacles in measuring fluorides. Since ions could not be separated, an estimate was obtained from the lab measurements of ions, and limits of influences were determined. The fluoride steam distillation

separation method was examined. As a result of a recovery rate test, the temperature of distillation was found to influence fluoride separation and elimination of obstacles. When measuring particle fluorides, the amount of fluoride contained in the filter influences the measurement in the air. An analysis of a sampling filter showed that a considerable amount of fluoride was contained in the filter itself.

44596

Largent, Edward J.

CHEMICAL ANALYSIS OF TRACE QUANTITIES OF FLUORIDE. In: Fluorosis. The Health Aspects of Fluorine Compounds. Columbus, Ohio State Univ. Press, 1961, Chapt. 11, p. 101-108.

In the Willard and Winter method for separating a fluoride from interfering substances, the ashed biological sample is boiled in a distilling flask with an acid, sulfuric or perchloric. Water is added as drops of liquid or as a jet of steam and the operation continues until all of the fluoride has been distilled out of the ash. The volumes of distillate may vary between 100 and 500 ml. Once fluoride has been separated from the ashed sample, it may be assayed by measuring its bleaching effect on certain colors. The thorium-alizarin titration is the fastest colorimetric procedure for measuring fluoride in distillate. Several techniques have been used for carrying out the thorium-alizarin titration, including back titration, direct titration, and titration against a permanent color standard. The entire analytical procedure from collection of samples to titration of distillate is described in detail. Reliability of determinations is quite satisfactory for samples of air, water, urine, feces, and bone.

44689

Lemoine, R.

MONITORING METHODS FOR THE GASEOUS EFFLUENTS OF ALUMINUM PLANTS. Preprint, American Inst. of Mining, Metallurgical, and Petroleum Engineers (AIME), New York, N. Y., 10p., 1972. (Presented at the American Inst. of Mining, Metallurgical, and Petroleum Engineers Annual Meeting, New York, Feb. 26-March 4, 1971.)

The methods used by aluminum plants to monitor gas-scrubbing processes are still rather empirical and the rigorous distinction between gaseous and solid fluorides is not possible due to the lack of precise knowledge of the adsorption and desorption properties of the solids. It is very difficult to get an accurate measure of the gas flow, and thus to know the actual amount of released fluorides. There is a pressing need for international standardization, mainly in sampling methods, to allow the aluminum producers to make process comparisons. These same difficulties exist for ambient air measurements of gaseous and solid fluorides. The relative toxicities of the solid fluorides are not well understood. Two general approaches exist for measuring the atmospheric concentration of gaseous fluorides. Automatic apparatus give punctual short-term data, but this data requires further data processing and the equipment is expensive. The inexpensive static methods in existence yield abundant but inaccurate data. Sampling procedures are discussed and special precautions for avoiding the common pitfalls of fluoride determination are outlined.

44710

Ferguson, William S.

APPENDIX 5 TO COMPLETE STATEMENT OF L. M. ALEXANDER. In: Problems of Electrical Power Production in the Southwest. Part 4. 92nd Congress (Senate), 1st Session, p. 1435-1444, 1971. (Hearings before the Committee on Interior and Insular Affairs, May 27, 1971.) GPO

The results of total fluoride analysis performed on nine water, 21 soil, four coal, and one fly ash sample are presented in tables. Also reported are radioactive concentrations in water, fly ash, and coal samples from Hayden, Colo., Craig, Colo., and the vicinity of the South Platte River in Colorado. A location key for the Hayden samples is provided.

44881

Jackson, Melbourne L.

PARTICLE-MOLECULE COLLECTION BY SONIC FLOW IMPINGERS. Preprint, Air Pollution Control Assoc., Pittsburgh, Pa., 31p., 1972. 20 refs. (Presented at the Air Pollution Control Association, Annual Meeting, 65th, Miami, Fla., June 18-22, 1972, Paper 72-6.)

A convenient, inexpensive, and sufficiently accurate method of sampling molecular and near micron and submicron particles, is described. Utilization of two sonic-flow impingers in a series is predicted to collect 98 to 99% of a phosphoric acid aerosol having a mass median diameter of 0.7 micron. The first impinger simultaneously collected 90 to 98% of the aerosol and 95% of molecular fluoride compounds in a field test. On the same aerosol, the standard Greenburg-Smith impinger had a low collection performance, less than 65% at sonic velocity. The utilization of a first impinger at sonic flow greatly simplifies sampling procedures by the need for a test meter and associated pressure and temperature measurements. Also, for small particle sizes, isokinetic sampling is not necessary and sampling line losses by deposition are less than 1%. The low initial cost of the sampling units and the low manpower requirements for setting up and supervising sampling make possible the taking of a number of samples sufficient to establish emissions over extended intervals of time. The equipment is especially suited to locations having multiple emission sources, or for locations requiring simultaneous sampling of many points. (Author abstract modified)

44933

Cante, Charles J. and Henri L. Rosano

ADSORPTION INDUCED ELECTRODE POTENTIAL (AIEP) CELLS FOR GAS AND VAPOR DETECTION. Preprint, General Foods Corp., White Plains, N. Y. and City Coll., New York, Dept. of Chemistry, 27p., 1969 (?). 11 refs.

Adsorption Induced Electrode Potential (AIEP) cells, can, by the judicious choice of electrode material and cell electrolyte, be made sensitive to either ionizable or non-ionizable vapors. The principal feature of the cell is a partially-exposed sensing electrode which permits the gaseous sample to react at the exposed electrode without prior dissolution of the vapor in the bulk electrolyte. The basic designs of AIEP cells for detection of halogen ions, acidic vapors, alcohols and aldehydes, aromatic compounds, pyrolytic products of halogenated solvents, hydrogen fluoride and its salts, carbon dioxide, ketones of low molecular weight, hydrogen sulfide, and basic vapors are described. Operational factors, including choice of electrochemical reaction, selection of detection potential, cell calibration, consideration of cell response mode and response time, and cell lifetime and sensitivity are discussed. The present AIEP concept is applicable to relatively volatile compounds (boiling point less than 180 C) because the cells cannot operate at high temperatures for any significant period of time. In addition, the vapor must be soluble in the cell electrolyte, otherwise it will be preferentially desorbed from the gas/liquid interface back into the vapor phase. The exception to this is

the case where the vapor reacts chemically with the electrolyte to produce an electroactive species.

45344

Bernard Michel-Louis, Michel Roux, Philippe Hobbes, and Roland Lucas

CONTRIBUTION TO THE STUDY OF THE FLUORINE-CARBON REACTION. III. DETECTION AND ANALYSIS OF ELEMENTARY FLUORINE. (Contribution a letude de la reaction fluor-carbone. III. - Detection et analyse du fluor elementaire). Text in French. Bull. Soc. Chim. France, no. 6:2203-2207, June 1972. 10 refs.

An instrument and method for the detection of elementary fluorine in air are described. The method is based on the variations in the electric conductivity of activated carbon caused by fluorine-contaminated air. Because a single carbon-filled measuring cell loses its reactivity to fluorine within a few hours, due to humidity forming hydrofluoric acid with elementary fluorine, a double-cell detector was developed. The air sampled at a rate of 7 l/min is first cooled to -30 C and then heated to 50 C before entering the first, non-selective measuring cell. Readings induced by agents other than elementary fluorine in the first cell are canceled by the selective second measuring cell which is filled with fresh activated carbon. The detection of fluorine concentrations of 0.04-8 ppm takes 1 min. The grain size of the activated carbon ranges from 0.200 to 0.315 mm. No interference due to water vapor, hydrochloric acid, and chlorotrifluoromethane was observed.

45760

D.P.R. APRIL 15, 1971, NO. 322: REGULATION FOR THE IMPLEMENTATION OF LAW NO. 615 OF JULY 13, 1966 DEALING WITH AIR POLLUTION CONTROL MEASURES APPLICABLE TO INDUSTRY. (D.P.R. 15 Aprile 1971, N. 322: Regolamento di esecuzione della legge 13 luglio 1966, N. 615, recante provvedimenti contro l inquinamento atmosferico, limitatamente al settore dell industria). Text in Italian. Igiene Sanita Pubblica (Rome), 27(9-10):429-432, Sept.-Oct. 1971.

The implementation regulation described, issued by the Ministero della Sanita, Direzione Generale Igiene Pubblica, is based on emission control at ground level where it has the strongest impact on public health. The law requires that its provisions be taken into consideration as early as the planning stage of the construction of an industrial enterprise, and that the best available pollution control technology be employed. All construction plans must be submitted to a regional committe which must render a decision within 60 days. Air samples must be drawn from around each enterprise at an altitude between 1.5 and 3 m above ground or above each obstacle. The regulation contains 13 supplements: supplement 1 and 2 deal with test instruments and test procedures; no. 3, with the determination of suspended inert particulates; no. 4, with SO2 determination; no. 5 with the colorimetric determination of chlorine; no. 6 with the determination of hydrochloric acid; no. 7 with the potentiometric and colorimetric determination of fluorine compounds; no. 8 with the colorimetric and potentiometric determination of hydrogen sulfide; no. 9 with the colorimetric determination of nitrogen oxides; no. 10 with the determination of suspended lead in the atmosphere; no. 11 with the spectroscopic determination of carbon monoxide; no. 12 with the determination of hydrocarbons from refineries by flame ionization methods; and no. 13 with the determination of free crystalline silica in particulate emissions by an X-ray diffraction method. In the choice of techniques three criteria have been considered: sampling efficiency, analytical specificity, and sensitivity, and feasibility of performing the test in a laboratory equipped with conventional instruments.

45802

Luiga, Peeter, Reet Liiv, and Roman Ott

INVESTIGATION OF THE LA/AC COLORIMETRIC METHOD FOR THE DETERMINATION OF AIRBORNE FLUORIDES. Preprint, Air Pollution Control Assoc., Pittsburgh, Pa., 13p., 1972. 5 refs. (Presented at the Air Pollution Control Association, Annual Meeting, 65th, Miami, Fla., June 18-22, 1972, Paper 72-1.)

The influence of various test conditions was investigated in the lanthan-alizarin complexan (La/AC) and fluoride reaction in order to establish optimum conditions for achieving high sensitivity and reproducibility of measurements. Photocolorimetric investigations were made in both the visible and the ultraviolet region of the spectrum. Solutions of standard fluoride, alizarin-complexan, lanthan-nitrate, and acetate buffer were prepared. Acetone, acetonitrile, methanol, ethanol, propanol dioxane, and dimethylformamide were compared for their effects on solution sensitivity. Of the tested solvents, acetone was the most suitable; its optimum rate in the final solution was 33%. Introduction of acetone cut down the stabilizing time in the reaction of the La/AC solution with the fluoride sample from 1 hr to 20 min, and sufficiently stabilized the solution for 24 hrs or more. Difference in optical density at 618 micron between the test solution and the corresponding blank appeared to be a maximum at pH 4.3. In the ultraviolet region of the spectrum at 280 micron, methanol, ethanol, propanol, and dimethylformamide were utilized because of the high absorbance of acetone. As a result, the sensitivity in the ultraviolet region was more than 50% higher than the sensitivity in the visible region. Except for sulfite, all the ions investigated had approximately the same effect on the density of the test solution in both the visible and the ultraviolet region. The diverse interference of sulfite was eliminated by its oxidation with hydrogen peroxide. The diverse effect of total sulfates was eliminated by their precipitation with benzidinhydrochloride. Aluminum ion was successfully eliminated by kationite. The ratio of lanthanum (III) to alizarin-complexan solutions, the rate of buffer, the type and the amount of the organic solvent and the pH value have considerable effect on the sensitivity of the method. The optimum values of these factors are in some cases dependent upon each other and on the fluoride concentration. (Author abstract modified)

46034

Cross, Frank, L., Jr. and Howard F. Schiff

MONITORING IN AIR POLLUTION CONTROL. Preprint, New Hampshire Univ., Durham and Air Pollution Control Assoc., Pittsburgh, Pa., 14p. 1971. 9 refs. (Presented at the Air Pollution Sampling Seminar, Windsor, Conn., Oct. 27, 1971.)

The impact of the 1970 Clean Air Act on air monitoring should increase the demand for source and ambient air sampling equipment by 500 to 700% in the 25-year period from 1975 to 2000. During this period, additional personnel, technicians, and instrumentation personnel will have to be added to the staff of governmental agencies and industrial firms. Because of the enormity of the task and the lowering of emission and air quality standards, more refined and less costly equipment for monitoring particulates, sulfur dioxide, nitrogen oxides, carbon oxides, mercury, hydrocarbons, chlorine, metals, hydrogen sulfide, hydrogen fluoride, fluorides, oxidants, odors, and other pollutants will also have to be developed. In addition, remote units for industrial monitoring and unitized equipment,

such as portable gas chromatographs, will also be in demand in the near future. Ambient and source sampling methods include colorimetry, coulometry, conductivity, infrared spectrometry, flame ionization detection, and Orsat analysis. The development and operation of a monitoring network is outlined.

46303

Peregud, Ye. A., Ye. V. Gernet, and M. S. Bykhovskaya

RAPID METHODS FOR THE DETERMINATION OF NOXIOUS SUBSTANCES IN THE AIR. (Bystryye Metody Opredeleniya Vrednykh Veshchestv Vozdukhe). p. 9-10, 17-41, 47-59, 62-70, 80-97, 182-186, 253-254, 1962. 22 refs. Translated from Russian. Foreign Technology Div., Wright-Patterson AFB, Ohio, Translation Div. 103p., April 8, 1971. NTIS, DDC: AD 726795

One of the most important aspects for safeguarding human health is the monitoring of the air in the plant, shop, or work environment. Rapid methods for determining a large number of substances which have a toxic effect upon the human organism are described. Sampling methods, method of preparing mixtures of toxic substances with air, calibration methods, and analytical procedures for the determination of oxides of nitrogen, hydrogen sulfide, sulfur dioxide, hydrogen cyanide, hydrogen fluoride, fluorine, and chlorine are included. Samplers include aspirators, absorption devices, and diffusion bottles. Colorimetry is the major analytical method discussed.

46443

Rechenberg, W.

RAPID DETERMINATION OF FLUORIDE IN RAW MATERIALS, CLINKERS AND DUST IN CEMENT MANUFACTURE. (Schnellbestimmung von Fluorid in Rohstoffen, Klinkern und Staeuben der Zementherstellung). Text in German. Zement-Kalk-Gips (Wiesbaden), 25(9):410-416, 1972. 25 refs.

At least 90% of the fluoride entering the cement kiln with the raw material leaves the kiln with the clinker. The rest is found in the dust in the form of solid calcium fluoride; the waste gases contain no gaseous fluorides. For better knowledge of the cycles of volatile matter in the cement kiln, an accurate determination is necessary of the fluoride content in silicates, for example in the raw material, the fuel, the cement clinker, and the dust. A modified method was developed to decompose and separate the fluoride in the silicates so it can be determined photometrically. During decomposition with alkalies, 0.1 to 1.0 g of the substance is treated with 4 g of lithium tetraborate by heating at 1000 C in a gold-platinum crucible for 10 minutes. After cooling, the tablet formed as a result of this decomposing conversion process is completely dissolved from the crucible. The tablet is transferred to the distilling flask of a Seel apparatus and decomposed with superheated water vapor in the presence of 20 ml of 60% perchloric acid and 0.7 g of silicagel. A distillation time of 20 minutes is sufficient to liberate 40 to 240 micrograms of fluoride from its compounds and distill it quantitatively into the receiver. The most favorable pH value for the formation of the color complex in the presence of tetraborate is 4.3 + or - 0.05. The method has no systematic error and possesses excellent correlation of extinction and concentration with a correlation coefficient equal to 0.999. The fluoride in raw meals, clinkers, and dusts in cement manufacture in a concentration of around 0.03% (by weight) can be determined with a repetition scatter of .0002% (by weight), while corresponding figures for concentrations of around 0.07% and 0.25% are 0.0004% and 0.004% (by weight), respectively. With this method it is possible to carry out 20 fluoride determinations in 2 days.

46784

Kuz mina, T. A. and N. Sh. Vol berg

DETERMINATION OF HYDROFLUORIC ACID IN THE AIR. (Opredelenlye ftoristogo vodoroda v atmosfernom vozdukhe). Text in Russian. Tr. Glav. Geofiz. Observ. (Leningrad), no. 254:172-177, 1971. 11 refs.

A colorimetric method for the determination of hydrofluoric acid in the air is described. Sampling is done by means of Richter type absorber equipped with filter, containing 5 ml of twice-distilled water, at a rate of 2-3 l/min over 20 min. The liquid sample thus obtained is combined with zirconium nitrate dissolved in 3.5n-hydrochloric acid. Xylene orange is added after 30 min, and the optic density is determined by means of photoelectric colorimeter after 3-5 min against a calibration curve obtained for a standard series containing 0.125, 0.25, 0.5, 1.0, 2.0, 4.0, 6.0, 8.0, and 10.0 micrograms of F per 5 ml. The sensitivity of the method for a sampling rate of 3 l/min and a sampling duration of 20 min is at 0.002 mg/cu m. The error is + or - 6%. While sulfate concentrations occurring in the air do not interfere with the determination, aluminum ion concentrations of 2 micrograms/ml or more cause interference.

47096

Ito, Shonosuke

METHODS AND TOOLS FOR THE MEASUREMENT OF HYDROGEN FLUORIDE AND CHLORINE GASES. (Fukka suiso gasu, enso gasu no sokuteiho to kikl). Text in Japanese. PPM (Japan), 3(11):41-47, Nov. 1972.

The basic methods of hydrogen fluoride analysis include the weight method, the titration method, the absorption spectrometry method, the filter paper fluorescence method, and the ion electrode method. Presently, colorimetry and ion electrode methods are employed in domestically manufactured apparatus. The alkaline filter paper collection method, alizarin complexion method, and Zr-ECR automatic analyzer are explained. The method of concentration, sampling tips such as care against evaporation and splash losses, tearing of filter paper, or dust in the tube, are given. For measuring chlorine gas, orthotolidine chlorine solution is used. Currently commercially available apparatus using orthotolidine colorimetry are discussed with a diagram.

47193

Atomic Energy Commission, New York, Health and Safety Lab.

SPECTROPHOTOMETRIC DETERMINATION OF FLUORIDE ION. In: HASL Procedures Manual. Rept. TID-4500, HASL-300, p. 01-01 to 01-05, 1972. 1 ref. NTIS: HASL-300

The analytical procedure for the determination of fluoride ions by spectrophotometry is outlined. The analysis depends on fluoride quenching of the thorium-chrome Azurol S lake. The apparatus and reagents requirement, sample preparation, and experimental techniques are reviewed. The method is applicable to air samples, air filters, water, or urine.

47218

Yanagisawa, Saburo

ON MEASURING METHODS OF AIR POLLUTION IN JAPAN AND THEIR PROBLEMS. Union of Japanese Scientists and Engineers, Proc. Int. Symp. Air Pollut., Tokyo, Japan 1972, p. 63-69. 27 refs. (Oct. 17-19.)

Methods in use in Japan for the measurement of sulfur oxides, oxides of nitrogen, carbon monoxide and dioxide, hydrocarbons, oxidants, chloride, hydrogen chloride, fluoride,

hydrogen sulfide, cyanide, ammonia, acrolein, mercaptan, bromide, phenols, particulate matter, and various other organic compounds, are listed. Their range of sensitivity is also indicated, in addition to whether they are batch or continuous methods. These methods include titration, photometry, conductivity, ultraviolet and infrared spectrometry, coulometry, lead dioxide, colorimetry, potentiometry, fluorescence, flame ionization, gas chromatography, gravimetry, impinger, impactor, counting, and chemiluminescence.

48315

Hamamoto, H., S. Hattori, H. Kono, and A. Kanazawa

MICRO-MEASUREMENT OF ATMOSPHERIC FLUORINE BY ALKALI FILTER PAPERS. (Arukari roshiho ni yoru taikichu fusso no biryo sokuteiho). Text in Japanese. Nippon Koshu Eisei Zasshi (Japan. J. Public Health), 19(10):421, Oct. 1972. (Presented at the Japan Society of Public Health, General Meeting, 31st, Sapporo, Japan, Oct. 25-27, 1972.)

The litmus paper and alkali filter paper methods can be used to measure fluorine concentrations. However, these methods usually require a lot of time and material. Alkali filter papers and positive ion exchange resins were tested to enhance knowledge of convenient testing methods. Alkali concentrations of 10, 20, and 30% were set up, fluorine was added, and the infrared-120 absorption was measured before and after disposition. The reduction of absorption prior to disposition was due to pH and carbonate. The infrared-120 disposition figure was similar to that obtained by a medium heating disposition. The infrared-120 dispostion method is extremely simple and can be used for a number of pollutants. Interference from strong winds and humidity was avoided by putting alkali filter papers around a cylinder with a 10-centimeter circumference.

48392

Berlyand, M. Ye. and N. Sh. Volberg

TEMPORARY PRECEDURAL DIRECTIVES FOR DETERMINING THE CONTENT OF POLLUTANTS IN THE ATMOSPHERE. (Vremennyye metodicheskiye ukazaniya po opredeleniyu soderzhaniya primesey v atmosfere). Hydrometeorological Service of the USSR, Moscow, 1971. 6 refs. Translated from Russian. 120p.

Systematic and efficient air pollution monitoring must include, along with air sampling and analysis for atmospheric pollutants, meteorological observations. Various techniques for air pollution monitoring and meteorological observations are reviewed. Sampling methods are reviewed for sulfur dioxide, hydrogen sulfide, carbon disulfide, nitrogen dioxide, phenol, hydrogen fluoride, chlorine, dust, soot, and carbon monoxide. Laboratory techniques, calibration, instrumentation, reagent preparation, and sample analysis are examined for photocolorimetric analysis (spectrophotometry and colorimetry). Equipment and techniques for measurements of wind speed and direction, air temperature, and humidity; criteria for determinations of weather characteristics (sky cover, haze, mist, rain, snow, fogs, and solar radiation); plume characteristics; and recording methods are also reviewed.

48492

Sakai, Kaoru

ANALYTICAL APPARATUS AND MEASUREMENT TECHNIQUES FOR TOXIC GASES. (I). (Yugai gasu no bunseki sochi to sokutei gijutsu (1)). Text in Japanese. Kankyo Sozo (Environ. Creation), 2(10):38-44, Oct. 1972.

For measuring sulfur dioxide, a sampling method using a filter and a trap, an analytical apparatus using electroconductivity, a flame photometric detector, a non-dispersive infrared gas analyzer, and gas chromatography used in combination with a flame photometric detector are explained with illustrations. For measuring hydrogen sulfide and bad odors containing sulfur, gas chromatography and flame photometry are used in combination. Fluorides and hydrogen fluoride are sampled in a sampling tube heated to 140 C to prevent condensation of test gas. A lanthanum-alizarin solution is used for analysis. A newly developed two wavelength spectrometer has a sensitivity hundred of times higher than previous analyzers. For measuring chlorine, orthotolidine colorimetry and a detector method are used according to the Japanese Industrial Standard. However, using any method, low concentrations of less than several ppm cannot be determined. For measuring hydrogen chloride, the Japanese Industrial Standard designates the thiocyanic acid secondary mercury method, the silver nitrate method, the neutralization method, and the continuous analysis method. The first is the most dependable, but is subject to the interference of halogen compounds and cyanides. Therefore, the electroconductivity method, although it does not give good repeatability, cannot be ignored.

48674

Okita, Toshiichi

MEASUREMENT OF GASEOUS AND PARTICULATE CHLORIDE IN THE ATMOSPHERE. (Taiki-chu gasujo oyobi ryushijo enkabutsu sokutei). Text in Japanese. Japan Society of Air Pollution, Proc. Symp. Japan Soc. Air Pollut., 13th, 1972, p. 113. (Nov. 7-9, Paper 68.)

The separation measurement method of particulates and gaseous compounds (hydrogen chloride mainly) was somewhat improved. The collection rate of gas by filter paper stays at 95% at 26 l/min whether the paper is soaked in a sodium carbonate solution of 5% or of 1%. Therefore, a filter paper soaked in sodium carbonate can be used for simultaneous capturing of hydrogen fluoride and HCl. The collection rate of a millepore LSWP 04700 filter was examined, using polystyrene particles of 0.365 micron diameter. The capturing rate was 99.9995% at 00 flow rate of 10 l/min. Sodium chloride was extracted from the filter paper using nitric acid of various concentrations; extraction was disrupted when the concentration was more than 1N. The improved method of collection and measurement is the use of two filters, one a millepore SLWP filter and the other a filter soaked in 1% sodium carbonate solution and dried. After filtering the gas for 2-4 hr at 20 l/min, the SLWP filter is soaked in scalding 0.5 N nitric acid, and the sodium carbonate filter is soaked in scalding water. Extracts are measured by the thiocyanic acid mercury method.

48916

American Industrial Hygiene Assoc., Analytical Chemistry Committee

ABSTRACTS OF INTERSOCIETY COMMITTEE METHODS FOR AMBIENT AIR SAMPLING AND ANALYSIS: REPORT I. Am. Ind. Hyg. Assoc. J., 33(4):269-278, April 1972. 13 refs.

Tentative methods for air sampling and analysis of various pollutants are presented including references, method of collection, principle of analysis, interferences, sensitivity, and reagents and equipment needed. Particulates containing arsenic can be collected on membrane or glass fiber filters and analyzed by colorimetry with a specrophotometer. Gaseous chlorides are collected by frittered glass absorbers or impingers; particulate chloride is collected by filtration, impingement, or electrostatic precipitation. Chloride can then be

analyzed by titration with mercuric nitrate solution using diphenyl carbazoneebromphenol blue as the indicator. Fluorides can be collected by dry collectors such as membrane or fiber filters or by wet collectors such as dilute alkaline solution or distilled water. Then fluorides can be manually determined by direct titration or spectrophotometry. The semiautomatic method relies on colorimetry. Three collection methods are used for nitrogen dioxide -- bubbler, glass syringe, and evacuated bottle methods; NO2 is analyzed by spectrophotometry or colorimetry using azo dyes. Total nitrogen oxides can be collected in flasks or bottles and determined by oxidation to nitrate which is reacted to phenoldisulfonic acid and by measuring the light absorption of the product. Bags are used to collect oxidants such as ozone which are determined by iodimetry. Grab samples of hydrocarbons can be analyzed by gas chromatography using a flame ionization detector and a chromatographic column. Polynuclear hydrocarbons, collected on glass fiber filters using a high-volume air sampler, are analyzed by benzene extraction and column chromatography separation followed by spectrophotometry or by cyclohexane extraction and column chromatographic separation followed by spectrophotometric and fluorimetric analysis. Benzo(a)pyrene analysis consists of collection on a hi-vol, micro-, or membrane filter and analysis by microanalysis with a spectrophotofluorimeter or a filter fluorimeter, by chromatographic analysis with chromatographic separation and fluorescence analysis, or by spectrophotometric analysis.

49391

Gilbert, Traugott

THE MONITORING OF INDUSTRIAL EMISSIONS. (Die Ueberwachung industrieller Emissionen). Text in German. Tech. Ueberwach. (Duesseldorf), 13(7/8):247-250, 1972.

Continuous monitoring is used for the measurement of particulates and sulfur dioxide. Boiler furnaces operated with solid or liquid fuels and with a heat production of more than 100 Gcal/hr are monitored continuously, as are cement plants. In the near future, iron and steel plants also will have to be continuously monitored. A brief description of sampling methods such as photometry, colorimetry, gas chromatography, and mass spectrometry is given. Measurements of gaseous and particulate emissions were taken in various plants. The hydrocarbon concentration from a naphthalene factory was to 1.0 to 5.0 g/cu m, and in anthracene melting plants 2.0 to 15.1 g/cu m. In the waste gas of brick kilns the gaseous fluorine compounds reached concentrations of 180 mg/cu m. The West German Federal Ministry of the Interior authorized two units for the continuous measurement of SO2 in waste gases of boiler furnaces (100 Gcal/hr), the Uras I and II. For the continuous measurement of dust emissions, the smoke density measuring units RM 3 and D-R/110 have been authorized.

49476

Nestaas, I. and O. Bjorseth

SAMPLING AND MEASUREMENTS OF EMISSION. Preprint, Norwegian Society of Professional Engineers, Oslo, 22p., 1972. 3 refs. (Presented at the International Symposium on the Fluoride Problem in the Aluminum Industry, May 24-26, 1972.)

Equipment designed to sample hydrofluoric acid and solid fluorides in gases at primary aluminum smelters is described, as well as optimum selection of sampling sites, sampling duration, and sampling frequency for fluoride measurements. A sampler was tested in a laboratory; it was composed of a spray arrester designed to separate droplets larger than 50 micron, a cyclone to reduce the loading on the filter during long periods of sampling uncleaned gases, membrane type acrylonitril-polyvinyl chloride filters with a pore size of 1.2 micron, a temperature sensor, a gas drier and condensate collector to be used in cold weather, and sieve-tray gas absorbers with 5% monobasic potassium carbonate. Sampling outlay for a plant with 168 closed prebake 150 kA pots is described. Emissions from each of the three sections and the performance of the scrubbers were checked monthly by sampling ventilation air in one fan and uncleaned and cleaned pot exhaust, simultaneously. Gaseous and solid fluorides were sampled separately. Uncleaned pot exhaust was sampled in the center of horizontal ducts ahead of the scrubbers. Ventilation air was sampled below the fans to avoid segregation of solids due to centrifugal forces. Since emission of fluorides varies during the day, although not significantly, duration of sampling should be 24 hours. The annual average emission can be measured fairly accurately by sampling six sections four times a year.

49509

Shirasawa, Tadao

HARMFUL GAS MEASURING EQUIPMENT. (Yugai gasu sokutei kiki ni tsuite). Text in Japanese. Netsu Kanri to Kogai (Heat Management Public Nuisance), 25(2):77-83, Feb. 1973.

Measurement methods as described in Japanese Industrial Standards are discussed for sulfur oxides, nitrogen oxides, chlorine, hydrogen chloride, fluorine compounds, and hydrogen fluoride. Dust concentrations and lead and cadmium content in dust should be analyzed by polarography. Sulfur oxides are measured by electroconductivity (suitable for concentrations up to 10,000 ppm). Ultraviolet spectrometry can also be used to measure SO2 up to 10,000 ppm. The Saltzman method and chemiluminescence can be used to measure nitrogen oxides. Ultraviolet spectrometry is suitable for nitric oxide up to 1000 ppm concentration.

49752

Japan Environmental Agency

INSTRUCTIONS FOR AIR QUALITY MEASUREMENTS AND OTHER ENVIRONMENTAL INVESTIGATIONS. (Kankyo taiki chosa sokutei hoho nado shishin). Text in Japanese. 58p., Aug. 1972.

Instructions for sampling and measuring methods of air pollutants are given. Sulfur oxides in the air are collected in a 0.006% hydrogen peroxide aqueous solution having a sulfuric acid concentration of .0001 N, and the concentration is measured by the conductivity method. Carbon monoxide and hydrocarbons are collected using a Mylar bag and are determined by infrared spectrometry and flame ionization, respectively. Airborne soot, and particulates including sulfate ion, nitrate ion, organic compounds, and metals are collected by a high-volume or low-volume sampler. Sulfate and nitrate are determined by the spectrophotometric method. Organic compounds are determined by the gravimetric method, and metals are determined by the atomic absorption method. Gaseous and granular fluorides are collected and separated by two-stage filters, a millipore filter, and a millipore filter impregnated with 1% sodium carbonate; they are determined by the fluoride ion electrode method or colorimetric method. Nitrogen oxides are collected in an absorbing solution prepared by dissolving 5 g of sulfanilic acid and 140 g of glacial acetic acid in 900 ml of water and adding to it 20 ml of 0.1% aqueous solution of N-(1-naphthyl)-ethylenediamine hydrochloride followed by dilution with water to 1 l and by determination by the colorimetric method.

49879

Sira Inst., Chislehurst (England), Market Research Section

POLLUTION AND ITS CONTROL: THE ROLE OF INSTRUMENTATION TO 1980. A STUDY OF THE UK SITUATION. Rept. SBN 9501842-2-5, 140p., 1971. 40 refs.

The form and nature of monitoring requirements with respect to air and water pollution and present and future demand in the field are reviewed. Pollutants and their sources, instrument applications, and technological developments are examined. The markets for pollution monitoring devices were calculated, including the trends of use of smokemeters, light interference instruments, and opacity measurement devices for smoke monitoring; titration techniques, gauges, and lead dioxide candles for sulfur dioxide determination; nondispersive infrared methods for the determination of SO2, carbon dioxide, carbon monoxide, and hydrocarbons; carbon monoxide monitors with thermal detection; chemiluminescence techniques for nitrogen oxides; and flame ionization detectors for hydrocarbons. The more recent developments include an automatic continuous recording meter based on the chemical reduction of SO2, laser-Raman devices for CO, NOx, and SO2; correlation spectrophotometers for NOx; fluoride monitors; odorimeters for atmospheric measurements; flame photometric detectors for SO2, ozone measurement techniques based on chemiluminescence; and techniques for monitoring lead compounds in car exhaust.

49992

Zurlo, Nicola

TECHNICAL CONSIDERATIONS ON THE ANALYTICAL METHODS INCLUDED IN THE REGULATION TO BE APPLIED BY THE INDUSTRY ACCORDING TO LAW NO. 615. (Considerazioni techniche sui metodi di analisi del regolamento di applicazione per l industria della legge 615). Text in Italian. Chim. Ind. (Milan), 54(9):801-804, Sept. 1972. (Presented at the Giornate della Chimica, 23rd Convegno, Milan, Italy, April 19-20, 1972.)

The antismog law No. 615 stipulates maximal permissible concentrations for all major industrial pollutants at 2 levels, i.e., 30-minute median concentrations for nine substances, and 24-hour median concentrations which are 3-4 times lower than the 30-minute concentrations. The median annual concentration is 15-20 times lower than the 24-hour concentration. Only the more precise and generally used measurement methods are permissible and these are stipulated in the regulation. Particulates are determined gravimetrically by a 5 cm membrane filter where a major source of error is the variation in the weight of the filter. Free silica is analyzed by the same method as inert dusts, but it is complex and subject to errors. The colorimetric method is prescribed for sulfur dioxide. If this method yields equal or a little lower values than the analysis of SO2 and sulfur trioxide combined then the presence of sulfates can be excluded. If the difference is large then it can be due to sulfate or to free sulfuric acid which must be determined. Nitrogen oxides are determined by the Saltzman method; for 24-hour median levels absorption with soda and subsequent colorimetry is prescribed. The methods leave much to be desired and all that can be done is to follow scrupulously the prescribed procedure. Chlorine is determined by the orthotoluidine method, hydrogen chloride by the sulfocyanaide reaction, hydrofluoric acid by colorimetry with a zirconium alizarin indicator or by a specific electrode, sulfuric acid by the methylene blue method or by a specific electrode, lead by colorimetry or by atomic absorption, carbon monoxide by the infrared method or by the iodine pentoxide method.

50093

Ohno, S., M. Suzuki, M. Kadota, and M. Yatazawa

DETERMINATION OF TRACE FLUORINE IN BIOLOGICAL MATERIALS BY PHOTONUCLEAR ACTIVATION ANALYSIS. Mikrochim. Acta, no. 1:61-68, 1973. 9 refs.

A photonulclear activation techniques was tested for measuring fluorine in air, water, and biological materials. After alkali fusion, fluorine was absorbed on an anion exhange resin. The irradiated resin was soaked and stirred in 5 N hydrochloric acid solution. After filtering, fluorine-18 resulting from the reaction was extracted with 0.2% dimethyldichlorosilane in xylene, and the fluorine-18 0.51 MeV annihilation peak in an aliquot of the organic phase was measured by gamma-ray spectrometry. The precision of this method calculated from replicate analyses of standard specimen was + or - 11%, and sensitivity was 0.01 micrograms for this element.

50337

Hinkley, E. D.

TUNABLE INFRA-RED LASERS AND THEIR APPLICATIONS TO AIR POLLUTION MEASUREMENTS. Opto-electron., 4(2):69-86, May 1972. 26 refs.

The application of tunable infrared lasers to the detection and monitoring of gaseous air pollutants was examined. The principle of operation, design, and monitoring techniques are reviewed. The various techniques include highly specific point sampling, in situ source monitoring, ambient air monitoring, resonance fluorescence, absorption and remote heterodyne detection. The lasers can be applied to the detection of carbon monoxide, hydrogen chloride, methane, hydrogen fluoride, nitric oxide, carbon dioxide, nitric acid, nitrogen dioxide, sulfur dioxide, hydrogen sulfide, peroxyacetyl nitrate, ozone, nitrous oxide, sulfur trioxide, formaldehyde, benzene, ethylene, and ammonia. (Author abstract modified)

50470

Shirasawa, T. and Z. Kawase

HARMFUL GAS MEASURING APPARATUS (2). (Yugai gasu sokutei kiki ni tsuite. (2)). Text in Japanese. Netsu Kanri to Kogai (Heat Management Public Nuisance), 25(3):51-58, March 1973.

The measurement method for chlorine consists of colorimetric determination using an orthotolidine solution. Another method uses ultraviolet rays for chlorine determination. Hydrogen chloride can be determined by electroconductivity or by colorimetry using a ferric sulfate ammonium and thiocyanate mercuric salt and photocells. Fluorine compounds can be determined by colorimetry and ion electrodes. These methods are continuous, automatic methods which are easy to maintain and control.

50876

Shirasawa, Tadao, Chotaro Ohno, and Kazuo Hishida

ANALYTICAL TECHNIQUES IN AIR POLLUTION. (Sokutei gijutsu). Text in Japanese. PPM (Japan), 4(4):116-136, April 1973.

Analytical techniques are described for testing sulfur in fuel, ash in coal and petroleum, and the heat generated by combustion. Instruments required for the control of combustion such as a gas analyzer, thermometer, and flowmeter are discussed. Particulate sampling by a dust tube or filter and analytical methods are mentioned. Analysis of fluorides, chlorine, and hydrogen chloride by colorimetry and calibration techniques are discussed. Atomic absorption spectrometry, colorimetry, and polarography are recommended for the analy-

sis of cadmium and lead. Other standard Japanese analytical methods are described.

50922

Giever, Paul M.

ALL ABOUT TAPE SAMPLERS. Pollut. Eng., 5(2):38-40, Feb. 1973.

Automated filter tape air samplers are sensitive, timer-controlled, portable instruments that operate with a very high degree of repeatability. They can sample or monitor all types of particulate matter and certain gaseous pollutants in ambient air. Designed to collect cyclical samples of polluted atmosphere, and to operate unattended for extended time intervals, these tape instruments perform widely varied indoor and outdoor air sampling applications. When used outdoors, the instruments should be suitably enclosed for weather protection and to discourage tampering. Tape instruments have been adapted to sample hydrogen sulfide and fluoride gases in the parts per billion range. Tape instruments have visually demonstrated the performance of a dust collecting system by taking simultaneous air samples on both sides of the collector unit. Particle samples collected on tapes may be evaluated by two different techniques. One uses light transmitted through the sample spot, and the other uses light reflected from the spot. In both techniques, the degree of soiling by particulate matter is determined by comparing the light reading of a sample spot (from 0 to 100% light transmission or reflectance) with a reading of 100% transmission or reflectance taken from the clean tape sections adjacent to the sample spot. Tape instruments are not suitable for air evaluations based on volumetric or mass measurements, such as the measurement of a certain weight of particulate matter in a specific volume of air.

50936

Sugano, Saburo

AN ANALYTICAL METHOD FOR POLLUTION AND ITS PROBLEMS. (Kogai bunsekiho to sono mondaiten). Text in Japanese. Preprint, Japan Society of Analytical Chemistry, Tokyo, 45p., 1973. (Presented at the Japan Society of Analytical Chemistry, Symposium on Pollution and Analytical Chemistry, 7th, Tokyo, Japan, March 16, 1973, Paper 3.)

Several analytical methods have been revised to make them simpler and more correct. The revised analytical methods are being tested in water and air analyses. Total mercury in water can be analyzed by an atomic absorption spectrophotometer. The reductive vaporization method, alkyl mercury method, and gas chromatography method are mentioned. Cadmium, lead, copper, zinc, iron, manganese, and nickel can be determined in water or particulate matter by an atomic absorption spectrophotometer. Chromium can be determined by trioctylamino-MIBK extraction an atomic spectrophotometer. Arsenic and cyanides can be determined by the silver diethyldithio-carbamate method. Fluorine and nitrogen can be determined by an ion electrode method. The 4-aminoantipyrine method is used to determine phenol. Total nitrogen compounds and nitrates can be determined by the nitric acid ion electrode method. Nitric oxide in air can be determined by the Saltzman or phenoldisulfonic acid methods.

51551

Salyamon, G. S. and M. V. Popelkovskaya

METHODS FOR THE DETERMINATION OF FLUORINE IONS IN AIR AND WATER. (O metodakh opredeleniya ftor-iona v vozdukh i vode). Text in Russian. Gigiena i Sanit., no. 4:65-67, 1973. 11 refs.

Twenty five different photocolorimetric methods for the determination of fluorine ions in air, water, and other media were tested for their specificity, accuracy, and reproducibility. Three methods using the respective reagents zirconium eriochrome cyanine, zirconium complex of 4-sulfophenylazo-1,8 dioxynaphthalene-3,6-disulfonic acid; and cerium alizarine complex, were retained as the ones satisfying the above criteria best. Wharton s method using a zirconium complex of 4-sulfophenylazo-1,8-dioxynaphthalene-3,6-disulfonic acid was modified by reduction of the chelate concentration and by addition of thiourea. The cerium alizarine complex method was modified to improve solubility. All three reagents were specific for fluorine even in the presence of several other ions in concentrations of 100 to 10,000 micrograms. The zirconium complex method was more specific than the zirconium eriochrome cyanine and the cerium alizarine complex methods. The zirconium complex and the zirconium eriochrome cyanine methods are suitable for the determination of fluoride dusts and aerosols in the air. An air sample volume of 15-20 l is taken at a rate of 2 l/min for the determination of hydrofluoric acid concentrations. In winter, as well as for the determination of fluorides and fluorine, the Yarovskaya absorber with silicagel is used.

51599

Warner, Theodore B. and David J. Bressan

DIRECT MEASUREMENT OF LESS THAN 1 PART-PER-BILLION FLUORIDE IN RAIN, FOG, AND AEROSOLS WITH AN ION-SELECTIVE ELECTRODE. Anal. Chim. Acta, 63(1):165-173, Jan. 1973. 21 refs.

A potentiometric method for the determination of fluoride in rain, snow, fog, and aerosols in samples containing as little as 0.28 ppb was developed using a lanthanum fluoride electrode. The method involves little sample handling, takes 15-22 min for a determination, and can be extended over eight decades of concentrations. Probable uncertainty ranges from 10-20% near 0.28 ppb to 3-6% above 100 ppb. (Author summary modified)

51762

Cross, Frank L., Jr. and Howard F. Schiff

MONITORING AIR POLLUTION. Plant Eng., 27(6):94-96, March 22, 1973.

The major goals for air pollution monitoring and various analytical and measuring techniques are reviewed. Most of the current monitoring effort is for particulates, sulfur dioxide, nitrogen oxides, hydrocarbons, carbon monoxide, and photochemical oxidants. The recommended sampling and analytical procedures include colorimetry, coulometry, conductometry, and chemiluminescence analysis for SO2; colorimetry and electrochemical methods for NOx; continuous sampling, non- dispersive infrared analysis, and flame ionization detection for CO; chemiluminescence techniques and colorimetry for ozone; high-volume sampling for particulates; and gas chromatography, colorimetry, and flameless atomic absorption for hydrocarbons, fluoride, and mercury, respectively. Chlorine, metal, hydrogen chloride, and hydrogen sulfide methods are mentioned. Costs are cited.

52101

Borkowska, Maria, Artur Strusinski, and Halina Wyszynska

COLORIMETRIC METHOD OF DETERMINATION OF FLUORINE IN ATMOSPHERIC AIR. (Kolorymetryczna metoda oznaczania fluoru w powietrzu atmosferycznym). Text in Polish. Roczniki Panstwowego Zakladu Higi., 24(1):109-114, 1973. 35 refs.

The methods of fluorine determination in atmospheric air are described. A number of modifications of the colorimetric methods of fluorine determination of Belcher, Leonard, and West are mentioned. The technique of fluorine determination in atmospheric air using alizarin and lanthanum salts in a modification is described in detail. The optical density is read on the spectrophotometer with 620 nm wavelength. The detection threshold of this method is 0.5 micrograms in a 5 ml sample; this enables the detection of 8 micrograms/cu m using 60 l test air. The sensibility of the method can be increased by measuring the absorbance on the spectrophotometer using 281 nm wavelength.

52206

Rooth, R., O. K. Bockman, K. O. Hagen, and A. Tokerud

MEASUREMENT OF FLUORINE EMISSION FROM ALUMINUM SMELTERS--A NEW AND MORE CORRECT METHOD. Preprint, American Inst. of Mining, Metallurgical, and Petroleum Engineers, New York, Metallurgical Society, p. 327-340, 1973. 1 ref. (Presented at the American Institute of Mining, Metallurgical, and Petroleum Engineers, Metallurgical Society, 1973, Paper A73-23.)

Most methods for sampling the fluoride content of fumes from aluminum smelters are unsatisfactory since the sampling trains are not equipped to collect submicron particulate fluorides. Improved sampling equipment has the ability to determine separately gaseous fluorine, coarse particulate fluorides, and fine particulate fluorides. In addition, particle size distribution can be evaluated. The sampling train for gas and dust includes a replaceable probe nozzle, a heating and cooling device, two cyclones for the collection of coarse particulates, a cellulose nitrate filter for collection of fine particulates, and absorption bottles for hydrofluoric acid. After sampling, concentrations are determined through weighing and analyses in the laboratory. In addition to the probe nozzle, cyclones, and filter, the equipment for particle size distribution includes a miniature electrostatic precipitator on which submicron dust is deposited. Collecting electrodes provide direct introduction into scanning or electron microscopes. The equipment is valuable for predicting the factors that affect wet scrubber performance. A correlation between scrubber pressure loss, cleaning efficiency for total fluorides, and raw gas composition is presented.

52629

Giang, Benjamin Yunwen

DEVELOPMENT OF A GAS CHROMATOGRAPHIC DETECTOR SELECTIVE FOR FLUORINE-, CHLORINE-, AND SULFUR-CONTAINING COMPOUNDS, USING ION SELECTIVE ELECTRODES. California Univ., Davis., Dept. of Agricultural Chemistry, Thesis (Ph.D.), Ann Arbor, Mich., Univ. Microfilms, Inc., 1972, 139p. 141 refs.

A highly selective potentiometric gas chromatographic detection system for the analysis of fluorine-, chlorine-, and sulfur-containing compounds was developed and tested. The essential units include a common flow-through unit equipped with an ion selective sensing electrode and a reference electrode located slightly downstream. The design and operation variables are examined. The system was tested with aqueous standard solutions and gas samples. The minimum detectable amounts were about 3.4 micrograms of fluorine for each compound, 135 ng of chlorine, and about 1.0 ng of sulfur. The application of the system to the detection of pesticide residues was investigated.

52992

VDI (Verein Deutscher Ingenieure), Duesseldorf (West Germany), Kommission Reinhaltung der Luft

INSTRUCTION FOR EMISSION MEASUREMENTS FOR WASTE INCINERATORS WITH THROUGHPUT CAPACITIES UP TO 1500 KG/HR. (Anleitung fuer Emissionsmessungen an Abfallverbrennungsanlagen mit Durchsatzleistungen bis zu 1500 kg/h). Text in German. VDI (Ver. Deut. Ingr.) Richtlinien, no. 2301:1-2, Sept. 1971.

Instructions for emission measurements of waste incinerators with throughput capacities of up to 1500 kg/hr are presented. Emission measurements should be performed during normal operation. Odor tests, as well as carbon monoxide, sulfur dioxide, hydrochloric acid, and hydrofluoric acid concentration measurements should be conducted in the gas duct. At least six measurements of a duration of 10 min, spread over 2 hr, are necessary for continuously charged incinerators. The dust content is determined by measuring a filter inserted in a partial flow, and by ignoring precipitated acid compounds. The waste gas temperature and composition should be continuously recorded. The waste gas plume is evaluated against the Ringelmann gray wedge. Bacharach soot indices should be determined at a point before the inlet of cooling air.

53523

Lehmden, Darryl J. von, Robert H. Jungers, and Robert E. Lee, Jr.

THE DETERMINATION OF TRACE ELEMENTS IN COAL, FLY ASH, FUEL OIL AND GASOLINE. PART I: A PRELIMINARY COMPARISON OF SELECTED ANALYTICAL TECHNIQUES. Preprint, American Chemical Society 19p., 1973. 8 refs. (Presented at the American Chemical Society Meeting, Symposium Analytical Methods Applied to Air Pollution Measurements, Dallas, Tex., April 1973.)

As part of a program to monitor trace elements in fuels and related atmospheric emissions, nine laboratories determined the concentrations of 28 elements in the same fuel and fly ash matrices. Among the elements studied were mercury, beryllium, lead, cadmium, arsenic, vanadium, manganese, chromium, and fluorine. The analytical methods used included neutron activation analysis, atomic absorption, spark source mass spectrometry, optical emission spectrometry, anodic stripping voltammetry, and x-ray fluorescence. At least eight trace elements in coal, fly ash, and residual fuel oil and three trace elements in gasoline were reported in concentrations varying by more than one order of magnitude. This wide range in reported results indicates that different sample preparation and analytical techniques can lead to erroneous conclusions and points out the need for developing standard reference materials certified in trace elements which can be used for analytical methods evaluation and quality control. (Author abstract modified)

53625

Ihida, Mutsumi and Teruaki Ishii

DETERMINATION OF FLUORIDE IN STEELMAKING SLAG AND DUST BY ION-SELECTIVE-ELECTRODE METHOD. (Ion sentaku denkyokuho ni yoru seiko suragu oyobi baijinrui no fusso no teiryo). Text in Japanese. Nippon Kokan Giho (Tokyo), no. 69:55-60, June 1973. 9 refs.

The determination of fluoride in steelmaking slag and dust by the ion selective electrode method was investigated. The sample was weighed and fused with sodium peroxide in a nickel crucible and dissolved in water. After the precipitation of hydroxide, part of the solution was taken into a 100 ml beaker

where a buffer solution was added to regulate pH. The volume of the portion was adjusted to 100 ml, and the electrodes were dipped into it for the measurement of electromotive force. The amount of fluoride is read out from a calibration curve.

53876

Ohkita, Toshiichi

DETERMINATION OF FLUORIDES IN EMISSION SOURCES AND IN THE ATMOSPHERE, AND THEIR PROBLEMES. (Endoo haigasu-chu oyobi taiki-chu no fukkabutsu no bunseki to mondaiten). Text in Japanese. Kogai to Taisaku (J. Pollution Control), 9(4):359-365, April 1973.

The measurement of fluorides in emission sources and in the atmosphere is described including sampling tube, absorbing solution, filter, analytical methods and instruments, and problems. The use of stainless steel and copper tubes in the sampling of fluorides is not recommended because of the reaction of hydrogen fluoride with these metals. A teflon tube is very useful. The correct selection of a dust filter is very important in obtaining correct data. The continuous automatic measurement of hydrogen fluoride in stack gas with a selective electrode and colorimetry was investigated. The determination of HF is attainable with an absorbing efficiency of almost 100%, even though the gas flow rate is 24 l/min.

53987

Ivie, James O.

GASEOUS FLUORIDE SAMPLING ON INDUSTRIAL STACKS. Preprint, Air Pollution Control Assoc., Pittsburgh, Pa., 20p., 1973. 3 refs. (Presented at the Air Pollution Control Association, Annual Meeting, 66th, Chicago, Ill., June 24-28, 1973, Paper 73-171.)

A stack sampling design that eliminates the loss of hydrogen fluoride in sampling lines by using an absorber system in the stack is described. The absorbing solution is pumped into the stack where it enters with the gas sample into the line running to the sensor. The HF is absorbed in the first few inches and is carried to the liquid air separator in the liquid where the sensing cell then measures the HF present. A temperature drop on leaving the stack and high humidity in the stack do not affect the results. The modified coulometric method provides for specific sensing of HF on five full scale ranges between 1/2 ppm to 800 ppm. Response time is 1 min. Fifteen min is required for stable values after a step change while recovery time takes 30 min. (Author conclusions modified)

55125

American Society for Testing and Materials, Philadelphia, Pa., Committee D-22 on Sampling and Analysis of Atmospheres

STANDARD METHOD OF TEST FOR INORGANIC FLUORIDE IN THE ATMOSPHERE. Book ASTM Stand., 1971:371-380, 1971. 8 refs.

A method for analyzing various types of atmospheric samples for total fluoride ion in the range from 0.005 to 10 mg is presented. It is intended primarily for inorganic fluorides and is not applicable to certain organic fluoride compounds. Too much acid in the distillate, residual amounts of fluoride in the distillation flasks, sulfuric acid, large amounts of aluminum or silicon, borates, phosphates, sulfates, nitrates, peroxides, sulfides, and sulfites interfere with the procedure and/or results. Reagents are calcium oxide, chloroacetate buffer solution, hydrochloric acid, hydrogen peroxide, perchloric acid, phenolphthalein solution, silver perchlorate solution, sodium alizarin monosulfonate solution, sodium fluoride, sodium hydroxide, sodium hydroxide solution, thorium nitrate, and thorium nitrate solution. Sampling procedures are given for gaseous inorganic fluorides, inorganic fluoride particles in the absence of gaseous fluorides, mists containing inorganic fluorides, and mixtures of gaseous and particulate inorganic fluorides. Preparation of the sample for distillation is discussed, along with distillation of the fluoride, titration of the fluoride, and calculation of the fluoride ion content of the total distillate.

55367

Habel, Karl

PRESENT STATE OF THE MEASURING TECHNIQUE FOR THE DETERMINATION OF THE FLUORINE CONTENT IN IMMISSIONS AND EMISSIONS. (Derzeitiger Stand der Mebtechnik zur Bestimmung des Fluorgehaltes in Immissionen und Emissionen). Text in German. Arch. Eisenhuttenw., 44(9):697-702, Sept. 1973. 7 refs.

The difficulties encountered in the separation of gaseous and solid fluorine compounds are described. If precise data can be given on the concentrations, reasonable predictions will only be possible. The same criteria must be valid for emission ground level emission (immission) measurements because of their close relationship. Methods which yield optimum measurement results corresponding to the actual state of engineering should be examined. The experimental investigations revealed that a reliable procedure for the exact separation of gaseous and solid fluorine compounds is not yet available. A solution would be possible, if binding definitions for the limitation between gaseous and solid fluorine compounds are given and accepted. A procedure could be suggested for emission measurements enabling the determination of gaseous fluorine compounds with an exactness of 10 to 15%. The solid fluorine compounds can be determined on the basis of an exact determination of dust. (Author summary modified)

55789

Japanese Society of Public Health

A STUDY ON THE IMPROVEMENT OF THE METHODS OF INVESTIGATING HARMFUL SUBSTANCES -- ANALYSIS OF HARMFUL SUBSTANCES. (Yugai busshitsu no ekigakuteki chosa shuho no kairyo ni kansuru kenkyu -- yugai busshitsu no bunseki shuho ni kansuru kenkyu). Text in Japanese. 59p., March 1973. 9 refs.

Methods for analyzing pollutants present in samples taken from the human body are given. Alkyl mercury is analyzed by gas chromatography. Total mercury is analyzed by the reductive vaporization method. Cadmium, lead, copper, zinc, iron, manganese, nickel, and chromium are analyzed by atomic absorption spectrophotometry. Arsenic, vanadium, fluorine, and selenium are also discussed.

55858

Kassebeer, Gerd

CONTINUOUS MONITORING OF FLUORIDE EMISSION. (Kontinuierliche Messung von Fluoremissionen). Text in German. Ziegelind. (Weisbaden), 1973:356-359, Nov. 1973. 5 refs.

An instrument which records the concentration of gaseous fluoride compounds in flue gases was developed and tested for the monitoring of F emissions and control of the emission reduction process. The mode of operation of the instrument is described. Following activated carbon filtration of the flue gas specimen, the F compounds are absorbed into a buffer solution. The F ion content of the solution is measured by means of an ion-sensitive electrode. The F content of the flue gas is shown on a logarithmic scale. A report is given of the operat-

ing experience gained with the instrument at two brickworks. In the case of the first, an examination was made of the influence of a fuel oil additive on the F emissions, and in the second, the effectiveness of lime injection was studied.

55923

Hermann, Peter

COMPARISON OF FLUORINE CONCENTRATION MEASUREMENT METHODS. (Vergleich von Messverfahren der Fluor-Immissionsmessungen). Text in German. Proc. Int. Clean Air Congr., 3rd, Duesseldorf, West Germany, 1973, p. C60-C62. 10 refs.

Sampling and analysis of gaseous and particulate fluorine compounds is described. Gaseous fluorine compounds were absorbed in quartz tubes filled with carbonate-coated silver balls. The absorbed fluorine compounds were then analyzed by means of fluorine-sensitive electrodes in semi-automatic operation. Particulate matter containing fluorine compounds was separated in an electrostatic precipitator with 10 kV potential that was heated at 80-100 C to prevent adsorption of gaseous fluorine compounds. All surfaces contacting gases were gold-plated. High separation efficiency up to 3000 l/h capacity was determined. The fluorine concentration readings were lower when an electrostatic precipitator was used than when Herpertz pot only was applied.

56244

Ciosek, Aleksandra and Irena Kesy-Dabrowska

DETERMINATION OF FLUORINE COMPOUNDS IN THE AIR. (Oznaczanie zwiazkow fluoru w powietrzu). Text in Polish. Med. Pracy, 23(6):585-594, 1972. 26 refs.

A selective absorption colorimetric method for the determination of hydrogen fluoride, inorganic fluorides, and fluorosilicates in the air is presented. The method consists of passing air through a membrane filter and then through a sodium hydroxide solution and determining the fluorides colorimetrically in a reaction with zirconium oxychloride ($ZrOCl_2$) and sodium para- sulfophenylazochromotropate. Microdiffusion is used to eliminate cations interfering with the determination. Routine laboratory tests of the method were performed, and recovery of fluoride was almost 100%.

56572

Luiga, Peeter

A SYSTEM OF CUMULATIVE DETERMINATION OF AIR POLLUTANTS IN AREA SURVEYS. Proc. Int. Clean Air Congr., 3rd, Duesseldorf, West Germany, 1973, p. C130-C132. 10 refs.

A system for the cumulative determination of air pollutants in area surveys is described. The purpose of the system is to obtain only average and relative data about the pollutants from a great number of sampling sites within a grid. Distances between sampling sites is about 1 km, and the number of sampling sites can reach a hundred or more. Corrections are made after the initial period of measurements by installing additional cumulative test devices in locations with a high gradient of contaminant concentration and removing some devices from places of uniform pollution level. Sulfur dioxide measurements are made by the corrosion-weight loss method which compares favorably with the use of potassium carbonate impregnated filter papers. The same papers can be used for determination of nitrogen dioxide and fluorides. Carbon monoxide is measured with 1% lead chloride impregnated filter paper strips. Accumulation of organic contaminants is performed by gas chromatography column packing materials.

56681

Epstein, B. D.

ELECTROCHEMICAL METHODS OF POLLUTION ANALYSIS. In: Electrochemistry of Cleaner Environments. John O M. Bockris (ed.), New York, Plenum Press, 1972, Chapt. 6, p. 165-206. 162 refs.

Electrochemical analysis techniques for water and air pollution monitoring of ozone, oxides of nitrogen, sulfur oxides, carbon monoxide, and fluorides and fluorine are reviewed. The biggest shortcoming of redox electrochemical techniques, voltammetry, amperometry, and coulometry, is the requirement of extensive sample pretreatment in the form of reagent addition and deoxygenation. Sometimes this drawback can be eliminated by continual reuse or regeneration of reagents or by self-contained generation of hydrogen to be used for deoxygenation. Specificity in the case of selective ion electrodes is not always dependable, and there are additional effects from complexation and ionic strength that obscure the analysis. Electrochemical techniques, though admirable under laboratory conditions, appear to be a long way from on-line analysis.

56865

Kenneweg, Hartmut

THE PROBLEM OF RECOGNIZING AND DEMARCATING FUME DAMAGE ON AERIAL PHOTOS. (Zur Frage der erkennung und abgrenzung von Rauchschaden aus Luftbildern). Text in German. Mitt. Forst Bundesvers., no. 97:295-305, 1972. (Presented at the International Symposium of Forest Fume Damage Experts, 7th, Essen, West Germany, Sept. 7-11, 1970.)

Aerial photographic investigations of sulfur dioxide and hydrogen fluoride polluted forests in Germany indicate that color photos were more easily interpreted than black and white photos, and that false color photos were usually better than normal color photos. Damage symptoms invisible in the field remained invisible on the photos as well, and systematic morphological structure intensified the effects of damage such as foliage discoloration or defoliation, while variable habit makes interpretation more difficult. The basic element in the interpretation of forest damage is the individual tree crown, the size of which determines the photo scale. Photo quality, tree species, picture scale, and type and concentration of pollutant make it possible to rank individual crowns into three to five damage classes, although direct determination of the cause of damage is seldom possible. Particularly favorable conditions for photography make it possible to distinguish between old and fresh damage on Ektrachrome Infrared film. With regard to the spruce stands under investigation, there was a relative increase in damage towards the center of the pollution zone, and younger stands generally exhibited less damage than older stands. No demonstrable influence of slope direction was found on the degree of damage, although damage increases with increasing altitude. Pinus strobus stands exhibited the worst damage and fewer differences due to terrain.

57079

Pitak, O.

GAS CHROMATOGRAPHY OF INORGANIC FLUORINE COMPOUNDS. Chromatographia, 2(7):304-308, 1969. 40 refs. Translated from German, 9p.

A gas chromatograph for the analysis of volatile fluorides produced during the dry conversion processing of nuclear fuel by the fluoride method is described. Materials resistant to fluorine corrosion are used in the construction of the chromatograph. Removal of traces of water from the carrier gas is accomplished by a hygrometric detector added after the sorp-

tion columns. A modified electron capture detector accomplishes the small quantity analysis of corrosive material and reduces insensitivity to changes in pressure, flow, and temperature of the carrier gas. The detector allows the use of a temperature-programmed procedure.

57781

Ke, Paul J. and Lloyd W. Regier

DETERMINATION OF FLUORIDE IN SOILS BY A NONFUSION DISTILLATION PF METHOD. J. Fish. Res. Bd. Can., 28(7):1055-1056, 1971. 6 refs.

A nonfusion distillation pF method has been successfully applied to the determination of fluoride in soils. Fluoride was distilled from the soil sample with perchloric acid and measured in the buffered distillate by an ion-specific fluoride electrode without any ashing or separation operations. Soils or mud containing fluoride in the range between 1-700 ppm were directly analyzed with a standard error of less than 1.5%. Direct weighing of the sample into the distillation flask with no prior treatment eliminated all question of possible fluoride loss before distillation. (Author abstract modified)

58278

Sunahara, H., M. Goto, and F. Korte

POSSIBILITIES AND PROBLEMS OF AUTOMATIC MEASUREMENTS OF ENVIRONMENTAL CHEMICALS. In: Environmental Quality and Safety: Chemistry, Toxicology and Technology. Frederick Coulston and Friedhelm Korte (eds.), Vol. 1, New York, Academic Press, Inc., 1972. p. 189-209. 43 refs.

The parameters for air and water quality, the establishment of air and water quality criteria, and the efforts made in the USA and Japan for monitoring concentrations of a number of compounds in these media, are discussed. Efficient automatic monitoring systems (including systems for sampling, treatment, detection and determination, and data processing) for important pollutants in air and water are described in detail. The air concentrations of sulfur dioxide, nitric oxide, nitrogen dioxide, carbon monoxide, total oxidants, total hydrocarbons, hydrogen sulfide, hydrogen fluoride, and dust or air particulates have been continuously monitored. Colorimetry, conductimetry, coulometry, non-dispersive infrared spectrometry, gas chromatography, flame ionization detectors, and ion-electrode methods are discussed.

58842

Ihida, Mutsumi and Teruaki Ishii

DETERMINATION OF FLUORIDE IN STEELMAKING SLAG AND DUST BY ION-SELECTIVE-ELECTRODE METHOD. (Ion sentaku denkyokuho ni yoru seiko suragu oyobi baijinrui no fusso no teiryo). Text in Japanese. Nippon Kokan Giho (Tokyo), no. 60:55-60, 1973. 9 refs.

Spectrophotometric methods have been used for the determination of fluoride in steelmaking slag and dust for pollution control purposes. But these methods require sophisticated analytical techniques and operations. Ion-selective electrodes are therefore being tested. In spite of many applications of these electrodes to rivers and waste water, there have been only a few applications of them to slag and dust analyses. Electrical conditions to be satisfied by the measuring instrument, the method of dissolving the sample, the effect of pH and ion interference, and the establishment of a favorable analytical procedure permitting simple and rapid measurement at high accuracy were studied. The sample was weighed and fused with sodium peroxide in a nickle crucible. The fused matter was dissolved in water. After the precipitation of hydroxide, part of the solution was taken into a 100 ml beaker, and buffer solution was added to this portion to regulated pH. The volume of the portion was then adjusted to 100 ml, and the electrodes were dipped into it for the measurement of electromotive force. The amount of fluoride was read out from a calibration curve.

59049

Kaaijk, J.

POTENTIOMETRIC METHOD FOR THE DETERMINATION OF AIR POLLUTION BY FLUORIDES. (Une methods potentiometrique pour determiner la pollution fluoree de l atmosphere). Text in French. Inst. Natl. Rech. Chim. Appl., Dixieme Colloq. Atmos. Polluees, Proc., Paris, France, 1972, 13p. 4 refs. (May 3-5.)

Sampling techniques and potentiometric methods for determination of fluorine compound concentrations in the air are described. A variation of an Adams sampler with dripping capillary, and buffer solution composed of sodium carbonate, citric acid, and sodium CDTA at pH 5.5 are used for the absorption and concentration of the fluorine compounds. To obtain good separation of gaseous from particulate fluorine compounds, particles larger than 1 micron are captured before reaching the sampler. The fluorine concentration is determined by means of a fluorine-specific electrode which measures potential difference against a calomel reference electrode in the presence of fluorine ions. By replacing the buffer solution every 24 hr, it is possible to measure fluorine ion concentrations in a range of 0.05-15 micrograms/cu m.

59513

STACK MONOTORING. New Hampshire Univ., Durham Center for Industrial and Institutional Development, Air Pollut. Sampling Monit. Workshop, Durham, N. H., 1971, 69p. 64 refs.

A review is presented on stack monitoring and stack effluent analysis procedures. Both manual observation methods (Ringelmann) and automatic opacity measuring techniques (light transmittance) are covered for stack-smoke monitoring. Abstracts of collection and analysis procedures (preparation for sampling, sampling, sample processing, analysis, and calculation) as related to gaseous constituents of stack emissions are provided for the following: ammonia and ammonium compounds; organic acids; aldehydes; formaldehydes; oxides of nitrogen; fluorides; sulfur oxides; hydrocarbons; orsat analysis (carbon dioxide, carbon monoxide, oxygen, and nitrogen); and chlorine and chlorine compounds. Proposed test methods of the Environmental Protection Agency are also presented.

59814

Taniguchi, Naozo

PRESENT STATE AND FUTURE PROBLEMS OF POLLUTION MEASURING INSTRUMENTS. (Kogai keisokuki no genjo to kongo no kadai). Text in Japanese. Sangyo to Kankyo (Ind. Environ.), 3(4):24-29, April 1974.

Problems concerning automatic pollution measuring instruments are discussed. Air pollution measuring instruments can be qualitatively classified into three groups. The first group is measuring instruments which are commercially available and provide a high degree of accuracy but require some improvements to reduce frequency of maintenance. This group includes the carbon monoxide analyzer, sulfur dioxide analyzer, and hydrocarbon analyzer. The second group is new to the

market and requires more improvement in both accuracy and maintenance. It includes the nitrogen oxides analyzer, dust meter, chlorine analyzer, hydrogen fluoride analyzer, and hydrogen sulfide analyzer. The third group consists of those instruments that must still be developed, and includes a dust meter for emission sources and an odor densitometer. The CO analyzer, the SO2 analyzer for measurement at emission source, the sulfur oxides analyzer for measurement of environmental concentration, the NOx analyzer for measurement at emission source, and the HC analyzer for measurement of environmental concentration are discussed at length.

60010

Ranfft, K.

ON THE DETERMINATION OF FLUORINE BY GAS CHROMATOGRAPHY. (Zur gas-chromatographischen Bestimmung des Fluors). Text in German. Fresenius Z. Anal. Chem., 269(1):18-21, 1974. 4 refs.

A fast, simple, and accurate gas-chromatographic method for determination of fluorine in inorganic and organic substances is described. After dry ashing the fluorine reacts with triethylchlorsilane to triethylfluorisilane. The latter is determined by gas chromatography. The accuracy of the method is about + or - 2%.

60278

Israel, Gerhard W.

EVALUATION AND COMPARISON OF THREE ATMOSPHERIC FLUORIDE MONITORS UNDER FIELD CONDITIONS. Atmos. Environ., 8(2):159-166, Feb. 1974. 15 refs.

Atmospheric fluoride levels were monitored at up to 22 stations in the vicinity of an alumina reduction plant by bicarbonate coated tube samplers, by a dual paper tape sampler, and by limed filter papers as part of a field evaluation and comparison of the three fluoride monitors. The bicarbonate tube sampler allowed classification of fluoride emissions by physical state; total atmospheric fluoride in the vicinity of the plant was 13% in gaseous form, 64% in particulate form, and 23% in gaseous form sorbed on aerosols. The dual tape sampler showed the same separation characteristics for gaseous an/ particulate fluorides but was incapable of distinguishing between free gaseous fluoride and that sorbed on aerosols. A significant correlation appeared to exist between fluoride accumulation by limed filter papers and total gaseous fluoride content on an annual basis, confirming the fact that limed filter papers are good indicators for free gaseous fluoride. The limed filters were, however, rather insensitive to the particulate component. (Author summary modified)

60339

Sholtes, Robert S., E. H. Meadows, Jr., and J. B. Koogler

EVALUATION AND MODIFICATION OF FLUORINE SAMPLING AND ANALYTICAL METHODS. Environmental Science and Engineering, Inc., Gainesville, Fla., Environmental Protection Agency Contract 68-02-0600, Program Element 1A1010, EPA-650/2-73-007, 125p., Oct. 1973. 27 refs. NTIS: PB-230954/AS

Three fluoride sampling and analytical methods were evaluated and modified. The sampling methods are the Arthur D. Little method, the C. E. Decker method (EPA), and the Florida method. With care in placement of thy probes and operation of the train, the EPA F method can give results on comparative tests that are within 5%. Data collected using the three EPA F trains simultaneously at field sites indicated that variation between EPA trains can be as good as 5% and as poor at 24%. In the concentration range of 10-100 ppm F, the average collection efficiency of the EPA train using water was 58% and using 0.1 N sodium hydroxide it was 77%. However, for two runs at about 100 ppm F, the collection efficiency of a similar train was 90% in the range of 0-4000 ppm. Statistical analysis of the data indicated no significant difference between water and NaOH as absorbing reagents; nor did analysis reveal differences in collection efficiency at different flow rates. Statistical analysis comparing the results of the Florida and EPA train indicated no significant difference between the two methods at the 99% confidence level. (Author conclusions modified)

60410

Israel, Gerhard W.

A FIELD STUDY OF THE CORRELATION OF STATIC LIME PAPER SAMPLER WITH FORAGE ANC CATTLE URINE. Atmos. Environ., 8(2):167-181, Feb. 1974. 30 refs.

A fluoride monitoring program was conducted by 22 monitoring stations located within a 7 km radius of an alumina reduction plant in order to examine the use of limed filter papers as a tool for estimating the accumulation of fluorides in the food chain of foraging animals and for indicating the fluoride exposuree of cattle. The mean fluoride level in the excretion of cattle herds was predicted from limed paper measurements with a standard deviation of + or - 3 ppm, sufficient accuracy for estimating the chronic exposure of cattle to subacute fluoride levels; additional calculations showed the possibility of predicting average urinary fluoride level of single samples from three month average lime paper concentrations with a standard deviation of plus or minus 5 ppm. Assuming that the lime papers and the forage both absorbed mainly free gaseous fluorides, the correlation found between fluoride levels in forage and limed paper values should be generally valid in terms of a forage-lime paper conversion factor developed for the location monitored.

60419

Miyajima, Kunio

MEASUREMENT OF TOXIC GASES. (Yagai gasu no skoutei). Text in Japanese. Kagaku Kojo (Chem. Factory), 18(4):26-30, April 1974.

The toxic gases discussed here are sulfur oxides, nitrogen oxides, fluorides, chlorine and hydrogen chloride. Sampling methods, sampling equipment, and analysis methods are described. The analysis methods include: iodimetric, arse azo, chloranyl acid barium, electroconductivity, and infrared gas analysis for sulfur oxides; chemical PDS (phenoldisulfonic), nitric acid ion electrode, zinc reduction (NEDA naphthyl ethylene diamine method), chemiluminescence, infrared absorptin and ultraviolet absorption, and constant potential electrolysis for nitrogen oxides; lanthanum-alizarin complexon method photometry for fluorides; orthotridine method for chlorine, and thiocyanide mercury and silver nitrate methods for hydrogen chloride.

60553

Teller, Aaron J.

GAS SEPARATION FROM MIXTURES BY CHROMATOGRAPHIC VAPOUR-PHASE TECHNIQUE. (Verfahren zur chromatographischen Dampfphasenabtrennung einer oder mehrerer Komponenten eines Gasgemisches). Text in German. (Teller Environmental Systems, Inc., New York) W. Ger. Pat. 1,619,928. 7p., Feb. 22, 1973. (Appl. Nov. 15, 1967, 2 claims).

One or more components of a gas mixture are separate rapidly, selectively, and efficiently without the need for dilution, by passage through a bed of carrier material such as alumina, coated with a layer of 0.5-5 (1-2) molecules of a reagent which absorbs these components. The resulting complex is heated above the decomposition point to free the absorbed gases. Recommended absorption layer compounds are carbonates of sodium, potassium, lithium, calcium, cadmium, or barium for carbon dioxide; nicotinic acid or dimethylglyoxime for oxygen; iron(II) salts for nitric oxide; copper(II)-ammonium salts for carbon dioxide; sulfates of potassium, sodium, lithium, cadmium, or silver, or phenol, hydroquinone, or pyrogallol for sulfur dioxide, silicon tetrafluoride, hydrogen fluoride, hydrogen sulfide, or aromatic hydrocarbons.

60951

Peters, E. T., J. E. Oberholtzer, and J. R. Valentine

DEVELOPMENT OF METHODS FOR SAMPLING AND ANALYSIS OF PARTICULATE AND GASEOUS FLUORIDES FROM STATIONARY SOURCES. FINAL REPORT. Little (Arthur D.), Inc., Cambridge, Mass., Environmental Protection Agency Contract 68-02-0099, Rept. EPA-R2-72-126, Rept. 73757, 133p., Nov. 1972. 54 refs. NTIS: PB 213-313

The development of tentative procedures for sampling and analysis of fluorides emitted from various processes within the primary aluminum, iron and steel, phosphate rock processing, and glass manufacturing industries is reported. In most cases, the distinction is made between gaseous, insoluble particulate, and soluble particulate fluoride species. Stack emissions from most of the processes that were considered can be sampled in a manner that separates the particulate from the gaseous species. For the tentatively recommended procedure, the particulate is collected by means of a filter or electrostatic precipitator heated above the water dewpoint with gaseous fluorides subsequently collected in a series of water impingers maintained at room temperature. Some very wet process streams, such as for the production of diammonium phosphate, include considerable water entrainment, precluding a particulate collector. In this case, the particulate is collected in the impingers and soluble particulate fluoride cannot be distinguished from gaseous fluorides. Chemical analysis procedures have been developed which emphasize procedural simplicity but which also provide reliable and reproducible results. The fluoride-specific ion electrode has been found to be the most suitable approach for measurement of fluoride concentration. Direct measurements on impinger solutions after appropriate buffering appears feasible in many cases. Otherwise, fusion and distillation procedures are required to assure solubility and separation from interfering species. (Author summary)

61103

Harmsen, Hans

SEVENTY YEARS OF AIR MONITORING AND CLEAN AIR MAINTENANCE AT BAYER AG. (70 Jahre Luftueberwachung und Luftreinhaltung bei der Bayer AG). Text in German. Umwelthygiene, 25(2):37-39, Feb. 1974.

The history and the current practice of air pollution monitoring and clean air maintenance at the Bayer AG are described. Continuous sulfur dioxide concentration measurements have been conducted since 1954 by high-sensitivity automatic instruments. An automatic air quality monitoring network with 13 sampling stations and over 40 recording instruments in the Leverkusen area continuously measures the concentrations of such air pollutants as SO2, hydrogen sulfide, carbon monoxide, nitrous gases, carbon dioxide, hydrocarbons, and chlorine. Routine laboratory measurements of the phenol, aldehyde, aromatic amine, chloride, fluoride, and organic carbon are conducted. Visible emissions are monitored by closed-circuit television, and pollutant concentrations on the lee side of the emission sources are measured by a laboratory van. The switch from coal to fuel oil and natural gas, the use of filters, and the introduction of the Bayer double-contact sulfur acid production process have resulted in considerable reduction of the pollutant emissions for the last few years.

61692

Organisation for Economic Co-operation and Development, Air Management Research Group

SAMPLING AND ANALYTICAL TECHNIQUES. In: Air Management Problems and Related Technical Studies. p. 53-69, 93-95, 1972. 41 refs.

Present measurement capabilities are reviewed for those air pollutants specified to be of priority interest in respect to both effects and abatement. Gaps in measurement capabilities are indicated and future research program recommended. The pollutants discussed include: asbestos--no sampling problems since adequate organic membrane filters are available; carbon monoxide--no measurement problems for concentration normally found in urban atmospheres; fluorides--no continuous method for routine measurement, not possible to distinguish between gaseous, particulate, and organic fluorides; heavy metals and other elements--number of methods available, but costly and time consuming; organic lead (fuel additive)--methods available for separating and identifying total organic lead; non-metallic organic compounds--no routine methodology developed; nitrogen oxides--no direct methods for nitric oxide, Saltzman method for nitrogen monoxide and nitrogen dioxide; oxidants and ozone-- routine methods available for ozone, but not for other oxidants; sulfur compounds--adequate measurement methods available or being developed; odors--not studied in detail; pesticides--need for a total system of sampling and analysis.

61851

Kogai Mondai Kenkyukai

MEASUREMENT OF ATMOSPHERE. (Taiki no sokutei). Text in Japanese. Kankyo Joho Kagaku (Environ. Inf. Sci.), 2(4):48-52, Dec. 1973.

Methods of measurement and analysis of such pollutants and sulfur oxides, aerosol, carbon monoxide, nitrogen dioxide and oxidant have been formulated since 1969, and are mostly described by Japan Industrial Standards, such as JIS Z 8808, which is briefly explained. For sulfur oxides, JIS K 0103, and for its gas volume, JIS Z 8808 are applied. For sulfur content in petroleum fuel, the radio isotope method, JIS K 2273, JIS K 2547, JIS K 2541, or JIS K 2263, are applied. For dust, JIS Z 8808, for cadmium and its compounds and lead and its compounds, JIS K 0097, and for sample collection, JIS Z 8808 3 and 6 applied. For chlorine, JIS K 0106 (O-lysine method) and JIS K 0106 (continuous analysis method) are applied. For hydrogen chloride, JIS K 0107, and for fluorine, hydrogen fluoride, silicon fluoride, JIS K 0105, and for nitrogen oxides, JIS K 0104 are applied. For measurement of dust, JIS Z 8808, for carbon monoxide, JIS D 1030, for hydrocarbon, JIS D 1030, for lead compounds, the atom light absorption method and polarograph method, for nitrogen oxides, JIS K 0104, and for particles, JIS D 8804 are applied. In measuring automobile exhaust, JIS K 0099 is applied for ammonium, JIS K 0105 for hydrogen fluoride, JIS K 0109 for hydrogen cyanide, and JIS K 0098 for carbon monoxide. Methods of analyzing sulfur oxides, such as the neutralization method, iodine titration method, chloranil acid barium method, solution conductivity

ratio method, infrared gas analysis method, and detector tube method, are compared. For aerosol, JIS Z 8813 and the volume air sampler method are applied.

61859

Gutsche, B. and R. Herrmann

FLAME SPECTROMETRIC F ANALYSES BY MEANS OF THE SRF-BANDS. (Flammenspektrometrische F-Analysen mit Hilfe der SrF-Banden). Text in German. Fresenius Z. Anal. Chem., 269(4):260-267, 1974. 10 refs.

By nebulizing strontium salts (nitrates, for example) and introducing the aerosol into a flame, strontium fluoride bands are observed if fluorine compounds are nebulized simultaneously. These SrF-bands are useful for F analysis. The best flame for this purpose is the turbulent hydrogen-oxygen flame in contrast to experience in F-sensitive flame detectors for gas chromatography. The most suitable SrF band is the band at 580 nm. The detection limit is 9.2 micrograms F. The precision is + or - 1.6%. The dynamic range is more than one power of ten. Interfering influences from sodium and phosphorus are discussed in detail along with possibilities for overcoming them.

61896

Sekiuchi Teruo, Kaku Kikuchi, and Hikaru Sone

DETERMINATION OF FLUORIDE IN BIOLOGICAL SAMPLES BY NONFUSION DISTILLATION AND ION SELECTIVE MEMBRANE ELECTRODE METHOD. (Shokubutsu taichu fusso no jimsoku bunsekiho ni tsuite). Text in Japanese. Taiki Osen Kenkyu (J. Japan. Soc. Air Pollution), 8(3):266, Oct. 1973. 1 ref. (Presented at the Japan. Society of Air Pollution, Annual Meeting, 14th, Fukushima, Japan, Nov. 6-8, 1973, Paper 2.)

To quickly measure the fluoride pollution from a fertilizer plant and a tile manufacturing plant which is absorbed from the air into plants, a nonfusion distillation method was used. The F content in plant leaves was determined and the values were compared with those of Association of Official Agricultural Chemists method and the ion-electrode method. The test material was ashed, perchloric acid and silver perchlorate were added, and reflux analysis was done at 140 C. The ashes were distilled and the extract was measured by colorimetry. The best recovery rate was obtained with the reflux time of 3 hr. By this method, the recovery rate was 93.8%, by the AOAC method about 90%, and the measurements were approximately the same. When using ion selective membrane electrode method, the results were similar to the colorimetry values. The nonfusion distillation method proved to be simple and accurate.

61957

Tepper, L. B.

ANALYTICAL CONSIDERATION. In: Metallic Contaminants and Human Health. D. H. K. Lee (ed.), New York, Academic, 1972, Chapt. 10, p. 229-241.

The analysis of environmental metals is discussed and some specific techniques are presented. Airborne metals are almost always particulate rather than gaseous. Particulates can be collected on a filter medium through which air is drawn by a pump. Particulates can also be separated from the air by impingement in a liquid-filled collector or by precipitation of charged particles in electrostatic fields. Organolead or mercury compounds which exist as volatile non-particulate material may be extracted from the air by adsorption on charcoal or by direct reaction with a specific chemical reagent. Laboratory procedures for analysis include wet chemical and instrumental methods. Wet chemical methods are based upon the development of a color, the intensity of which is measurable and related to the amount of the metal being assayed. Instrumental methods of analysis includde spectrophotometry and spectroscopy. Preferred analytical techniques and standard values are given for arsenic, beryllium, cadmium, chromium, fluoride, lead, manganese, mercury, nickel, and vanadium.

61993

COLORIMETRIC ANALYZERS. (Kolorimetrie). Text in German. In: Elektrische Messgeraete fuer den Umweltschutz. Fachverband Messtechnik und Prozessautomatisierung im Zentralverband der Elektrotechnischen Industrie, Frankfurt, West Germany, 1973, p. 9-11, 21, 37.

The principle of the colorimetric analysis of gaseous pollutants, and commercially available colorimetric analyzers are described. The gas to be analyzed is contacted with a reagent solution for a certain time so that averaged concentration values are obtained. Colorimetric measurement is also possible by photoelectric comparison of color spots obtained on a reagent-soaked ribbon with a standard color. The Braun and Luebbe B and L-Imcometer is suitable for the measurement of the 30-min-concentrations of sulfur dioxide, nitrogen oxides, and oxidants by modified West-Gaeke and Saltzman methods. The measuring ranges are 0-0.25 ppm and 0-1.4 ppm for SO2, 0-0.2 ppm and 0-0.55 ppm for nitrogen dioxide, and 0-0.15 ppm and 0-0.3 ppm for chlorine. The MONOCOLOR colorimetric gas trace analyzer by Maihak uses reagent-soaked paper ribbon for the measurement of hydrogen sulfide, hydrofluoric acid, hydrochloric acid, phosgene and toxic gases in a concentration range of 0-0.2 ppm. The concentration is determined by measuring the difference in the brightness of the colored spot and of a non-exposed standard.

61995

POTENTIOMETRIC ANALYZERS. (Potentiometrie). Text in German. In: Elektrische Messgeraete fuer den Umweltschutz. Fachverband Messtechnik und Prozessautomatisierung im Zentralverband der Elektrotechnischen Industrie, Frankfurt, West Germany, 1973, p. 9-11, 21.

The principle of the potentiometric measurement of gaseous air pollutant concentrations, and commercially available potentiometric analyzers are described. The B and L-Sensimeter by Braun and Luebbe, developed for hydrochloric acid and hydrofluoric acid emission concentration measurement in the respective ranges of 20-2000 mg/N cu m and 0.2-20 mg/N cu m, uses buffer solution for the absorption of the test gas, and thermostatized measuring cell with ion-sensitive electrodes.

63848

Fuhrmann, Hans

RECORDING STACK MONITORING FOR THE CONTROL OF ENVIRONMENTAL PROTECTION MEASURES AND THE ECONOMIC CONDUCTION OF COMBUSTION PROCESSES. (Registrierende Schornsteinueberwachung zur Kontrolle des Umweltschutzes und des wirtschaftlichen Verhaltens von Verbrennungsprozessen). Text in German. Wasser Luft Betrieb, 18(4):212-217, 1974. 16 refs.

Methods for the measurements of the oxides of nitrogen, hydrogen, chloride, and fluoride are discussed in detail and a brief review of the methods available for the measurement of carbon monoxide, sulfur dioxide, and sulfur trioxide emissions

is given. The discussion of the NOx measurement methods is preceded by a review of the development of these components in industrial combustion processes. For the measurement of the oxides of nitrogen, the chemiluminescence method and the absorption methods in the infrared and ultraviolet range are described. For the measurement of HCl and HF emissions, samples are taken behind the electrostatic precipitator. The analyzer for these pollutants consists of an ion sensitive electrode. For the recording measurement of CO2 and SO2, a number of primarily physically operative analyzers in the IR and UV range are available. Also analyzers with chemical auxiliary reactions are used. The most difficult problem encountered at the measurement of SO3 is posed by sampling. Here the conversion of the SO2 present in the flue gas to SO3 through the material of the sampling of the sampling probe or the reaction of SO3 with the sampling probe or with dust must be taken into account. The sample flow is taken from the probe at a temperature above 450 C, filtered, and passed over heated pipes (200 C) to the analyzer. Of the familiar SO3 measuring methods such as dew point determination; measurement of the film-forming speed; scrubbing with isapropanol and subsequent photometry or conductivity measurement; and SO3 reaction with condensated water vapor, the two methods mentioned last have been in practical use for a longer period of time.

64090

Moser, E.

MEASURING INSTRUMENTS FOR DETERMINATION OF FLUORIDE IMISSIONS. Fluoride, 5(2):84-85, April 1972. (Presented at the International Society of Fluoride Research, The Hague, Netherlands, Oct. 24-27, 1971.)

Damage from gaseous fluorides such as hydrogen fluoride differs from that due to particulate fluoride. In evaluating fluoride damage to plants, the fluoride content of dust is relatively insignificant. In animals, fluoride absorption depends largely upon the solubility of the compound. An instrument is described for separating particulates from gaseous fluoride for use in determining the relative effects of the two types of fluoride. The instrument consists of a heated membrane filter. The sample is heated to avoid condensation of HF. The HF is absorbed either by an impinger or by an absorption tube with sodium hydroxide-loaded silver balls or bead spheres. The tested volume of air is about 2 cu m/hr. The method gives reproducible results. (Author abstract modified)

64779

Imagami, Kazunari

SELECTION OF MEASURING APPARATUS FOR AIR POLLUTANTS (2). (Taiki osen busshitsu no sokuteiki no sentei). Text in Japanese. Kogyo Kanetsu (Ind. Heating), 11(2):82-88, March 1974. 1 ref.

Measuring apparatus for analyzing air pollutants such as cadmium, lead, chlorine, hydrogen chloride, fluorine, hydrogen fluoride, hydrogen silicofluoride, nitrogen oxides, and other harmful substances are described. For heavy metals such as cadmium and lead, there are three methods, atomic absorption spectrophotometry, spectrometry, and polarography, each of which is accepted widely; atomic absorption spectrophotometry has, however, been most widely used. Emission spectrometry, X-ray fluorimetry, radiochemical analyzers, recently have attracted attention. Chlorine present in flue gas is mostly analyzed by the orthotolidine method in Japan, and hydrogen chloride is determined by the mercury thiocyanate method which is suitable for samples with a hydrogen chloride concentration of 2 to 40 ppm in cases where 40 l of sample gas are available and the effect of halide and cyanide is negligible. For fluorides in flue gas, spectrometry using a lanthanum-alizarin complex is adopted. Determination of nitrogen oxides in flue gas is done by the phenoldisulfonic acid method which is suitable for concentrations of about 10 to 20 ppm. The present general trend is toward using the PDS method, Rapid PDS method, chemiluminescence, and electrochemical methods.

64912

Thomas, Josephus, Jr. and Harold J. Gluskoter

DETERMINATION OF FLUORIDE IN COAL WITH THE FLUORIDE ION-SELECTIVE ELECTRODE. Anal. Chem., 46(9):1321-1323, Aug. 1974. 10 refs.

A fluoride ion-selective electrode method is described for the determination of F in coal. Coal samples are decomposed in a combustion bomb, the pH of the bomb contents is adjusted, and the solution is buffered prior to the determination of the fluoride concentration with the F ion-selective electrode. Analysis is by the addition method in which the change of potential resulting from the addition of a known volume of standard F solution to the initial test solution is used to determine the fluoride concentration of the initial solution. The technique is superior to direct potentiometry as problems resulting from interferences, complexation, and ionic strength variations are virtually eliminated. Analytical data are presented for coal samples decomposed by the bomb combustion method and by alkali fusion as well as for fluoride determinations of coal samples with test solutions at different pH values.

65118

Shcherban, O. N. and A. V. Prymak

PROTECTION OF THE AIR BASIN FROM POLLUTION AND AUTOMATION OF THE SANITARY-CHEMICAL CONTROL OF THE ATMOSPHERE. (Zakhyst povitrjanoho basejnu vid zabrudnennja i avtomatyzacija sanitarno-khimichnoho kontrolju atmosfery). Vestn. Akad. Nauk SSSR, no. 8:90-99, 1973. Translated from Russian, 18p.

A review is presented on the development of automated equipment in the Soviet Union for the detection and monitoring of air pollutants and for the interpretation of air pollution and meteorological data. Automatic gas analyzers are described for the detection of such pollutants as sulfur dioxide, hydrogen sulfide, ozone, acetone chlorine, nitrogen oxides, sulfurous anhydride, ammonia, amines, carbon monoxide, carbon dioxide, various hydrocarbon volatiles, alcohols, halogenated hydrocarbons, phosgene, carbon disulfide, formaldehyde, fluorine compounds, and total oxidants. Equipment is also being developed for the automatic measurement of particulates. Telemetry systems are used to connect various measurement stations with a center for collection and interpretation of air pollution and meteorological data.

65846

Birkle, Michael

ERECTION OF AN AUTOMATIC EMISSION MEASURING GRID. (Aufbau eines automatischen Immissionsmessnetzes). Text in German. Siemens Z., 48(8):525-532, 1974. 25 refs.

The structure, hardware, and software of an automatic air quality monitoring network is described. The smallest independent unit of the network is constituted by the data recording unit integrating up to four pollutant analyzers together with the necessary sampling and calibration units and up to four instruments for the recording of meteorological parameters. One or more of such data recording units can be accommodated in

one sampling station which is in turn connected to regional subcenters via remote control units. Apart from automatic operation, the individual data recording units can be also controlled manually. Final data processing is done in a computer center. The data recording centers are suitable for the concentration measurement of such air pollutants as sulfur dioxide, hydrogen sulfide, nitric oxide, nitrogen dioxide, total nitrogen oxides, carbon monoxide, carbon dioxide, ammonia, hydrochloric acid, chlorine, hydrofluoric acid, ozone, oxidants, and hydrocarbons.

66606

Birkle, M.

SETUP OF AN AUTOMATIC AIR POLLUTION MONITORING NETWORK. (Aufbau eines automatischen Immissionsmessnetzes). Text in German. Siemens. Z., 48(8):525-532, 1974. 25 refs.

The structure and functioning of automatic air pollution monitoring networks are described. Automatic monitoring networks are usually composed of measuring units which constitute the basic units of the system and which may include up to four pollutant analyzers complete with the corresponding calibration units, as well as up to four recording units for meteorological parameters. One or more of such measuring units together form one sampling station, and the sampling stations in their turn are connected to, and controlled by, regional sub-centers including process computers and remote control units. The measurement data received and reduced by the regional sub-center is transmitted to the computer center for processing, statistical evaluation, and warning initiation. The air pollutants to be monitored are selected from among the compounds sulfur dioxide, hydrogen sulfide, nitric oxide, nitrogen dioxide, total nitrogen oxides, carbon monoxide, carbon dioxide, ammonia, hydrochloric acid, chlorine, hydrofluoric acid, ozone, oxidants, total hydrocarbons, and dust. The SO2 and ozone concentrations can be used as leading pollutants for smog alarm.

66753

Blakeslee, H. William and Louis R. Reckner

ANALYTICAL TECHNIQUES IN AIR POLLUTION. In: Air Pollution and Industry, R. D. Ross (ed.), New York, Van Nostrand Reinhold Co., 1972, Chapt. 5, p. 248-280. 30 refs.

A review is presented on techniques for the sampling and analysis of air pollutants. The most common reaction for the noninstrumental detection of gaseous air pollutants is the colorimetric change which can be measured either visually or with a spectrometer. Dry chemical tests using indicating papers and tubes provide simple and rapid checks and are useful when the danger of toxic gases are present. The basic unit of the wet chemical air pollutant test is the absorption apparatus which may be either of the impinger type or the fritted glass scrubber, with the absorbed pollutants being subjected most often to colorimetric tests. The most basic form of instrumental techniques is also based on absorption, though in an automated manner, with the measurement often being done by a built-in colorimeter or conductivity cell. Such instruments are often used for monitoring sulfur dioxide, nitrogen oxides, ozone, chlorine, oxidants, cyanides, and sometimes carbon dioxide. Fluorides are better detected with fluorescence techniques as are nitrogen oxides. Hydrocarbons can be detected over a wide concentration range with a flame ionization detector. Air pollution instruments based on infrared spectrophotometry can be used for the measurement of CO2, carbon monoxide, SO2, O3, acetylene, ethylene, methane, ammonia, and peroxyacyl nitrates. Ultraviolet methods can be used for nitrogen dioxide, SO2, O3, and hydrocarbons. The gas chromatograph is one of the most versatile air pollution instruments and is able to separate complex mixtures. The mass spectrometer is capable of identifying small amounts of materials. Several instrumental techniques are also available for organic and inorganic particulate analysis. Odor threshold determinations can only be made by using the average reaction of a group of people.

67116

Sawicki, Eugene

ANALYSIS FOR AEROTOXICANTS. CRC Critical Rev. Anal. Chem., 1(3):275-333, Nov. 1970. 565 refs.

Analytical methods are reviewed for a variety of aerotoxicants. Toxic compounds considered include: carcinogenic polynuclear hydrocarbons (arenes, aza arenes, and imino arenes); cocarcinogens such as certain alkanes and phenols; polynuclear anticarcinogens; respiratory irritants such as benzene, acetyl peroxide, formic acid, 2-methylbutene-2, 2-methylpentane, peracetic acid, and propylene oxide; allergens of the protein and glycoprotein type, including pollens; coallergens and antiallergens; mutagenic and/or carcinogenic alkylating agents; lachrymators such as formaldehyde, acrolein, and peroxyacyl nitrates; and phytotoxicants such as ethylene, sulfur dioxide, ozone, oxidants, and fluorides. Analytical methods cited include: electrochemical techniques, chromatography, colorimetry, spectrophotometry, fluorescence techniques, various spectrometric methods including mass spectrometry, and histamine bioassay tecniques (for allergens).

67528

Habel, Karl

PRESENT STATE OF THE MEASURING TECHNIQUE FOR THE DETERMINATION OF THE FLUORINE CONTENT IN IMMISSIONS AND EMISSIONS. (Derzeitiger Stand der Messtechnik zur Bestimmung des Fluorgehaltes in Immissionen und Emissionen). Text in German. Arch. Eisenhuettenw., 44(9):6p., Sept. 1973. 7 refs.

The present state of measuring techniques for the determination of the fluorine content in immissions and emissions is reviewed. Topics covered include: the calculation of the characteristic immission data, comparison of different immission measuring procedures, problems in the separation of gaseous and solid fluorine compounds in immission and emission measurements, and the assessment of test results. Although a reliable procedure for the exact separation of gaseous and solid fluorine compounds is not yet available, a solution appears possible if binding definitions for the limitation between gaseous and solid fluorine compounds are given and accepted. A procedure is possible for emission measurements enabling the determination of gaseous fluorine compounds with an exactness of 10-15%; solid fluorine compounds can be determined on the basis of an exact determination of dust.

68086

Thompson, C. R., G. H. Farrah, L. V. Haff, W. S. Hillman, A. W. Hook, R. L. Saltzman, E. J. Schneider, J. D. Strauther, and L. H. Weinstein

SOURCE SAMPLING FOR FLUORIDE EMISSIONS FROM ALUMINUM, STEEL AND PHOSPHATE PRODUCTION PLANTS: A STATE-OF-THE-ART REPORT. Health Lab. Sci., 11(4):354-359, Oct. 1974. 9 refs.

The state-of-the-art of source sampling for gaseous and particulate fluoride emissions from aluminum and steel plants and

phosphate production facilities is reviewed. Particulate collectors employed for separation of gaseous and particulate fluorides in dry emission streams from primary aluminum and steel plants include electrostatic precipitators and high- efficiency filters. Some of the particulate is generally collected on the walls of the sampling probe. Insufficient data exist for demonstrating the effectiveness of in-stack filters for reducing the amount of particulate in the probe. All sampling trains employ impingers to collect gaseous fluorides, and differences in collection efficiency using water versus dilute caustic appear negligible. There is no provision for conducting a separation of gaseous and water soluble particulate fluorides in the case of wet streams from phosphate rock processing operations. The apparatus generally used for sampling stack emission is the same as for the dry stream industries, except for elimination of the particulate collector. The tendency of hydrogen fluoride to react with particulate matter on filters can be minimized in some cases by converting the HF to silicon tetrafluoride with a heated glass probe. The SiF4 is then collected in the impingers, hydrolyzed with dilute alkali, and analyzed by an appropriate method.

68229

Sekiuchi, Teruo, Kaku Kikuchi, and Mitsu Sone

RAPID QUANTITATIVE ANALYSIS OF FLUORINE IN PLANT. PART 2. (Shokubutsutai chu fusso no jinsoku teiryo ni tsuite dai ni ho). Text in Japanese. Miyagiken Kogai Gijutsu Senta Hokoku (Miyagi Prefect. Pollut. Contr. Tech. Center Rep.), no. 2:37-40, April 1974. 4 refs.

An ion selective electrode microanalytical method of determination of fluorine contained in plants was investigated. The sample plant was washed and dried in a vacuum dryer at 80 C for 4 hrs, and 5 g of the crushed sample was taken into a 300 ml flask and was carbonized with 0.5 g of quartz sand, 0.4 ml of perchloric acid, and 0.2 g of silver perchlorate at 130 C by 3 hr of reflux. By steam distillation, 200 ml of aqueous solution was obtained, of which 10 ml was mixed with 20 ml of TISAB (a buffer solution to adjust total ion strength). The electrostatic potential of the sample was measured 5 min later and fluorine concentration was determined by comparison with the calibration curve. It was found from the comparison of the results obtained by the present ion electrode method and the Alfusone colorimetric method that both methods gave the same results. Disturbance by metal ions on determination of fluorine concentration was checked. Addition of 0.1 and 1 mol of ferric ion to aqueous solution containing 0.5 ppm fluorine lowered apparent fluorine concentration by 15 and 70% respectively. Chlorine ion lowered the apparent fluorine concentration by 15% while other ions did not disturb the determination. The fluoride ion electrode method can be used as a practically useful microanalytical method for fluoride ion.

68559

Rudolph, H., J. J. Kraushaar, R. A. Ristinen, and Robert R. Meglen

DETERMINATION OF TRACE AMOUNTS OF FLUORINE BY NUCLEAR INELASTIC SCATTERING. Missouri Univ., Columbia, Trace Subst. Environ. Health, Proc. Univ. Mo. Annu. Conf., 7th, Columbia, Mo., 1974, p. 313-321. 23 refs.

The detection of inelastic scattering of energetic protons to the first (110 keV) and second (197 keV) excited states of fluorine (19) is a sensitive tool for detecting trace amounts of fluorine in a large variety of environmental and biological samples. Gamma rays following inelastic excitation of fluorine nuclei are observed with a lithium-drifted germanium detector of 1.8 keV resolution. With the method, the minimum detectable amount is approximately 10 ng, assuming a 15 minute irradiation of the sample with a 4.8 MeV proton beam of current density of 0.5 microA/sq cm. Obvious improvements in experimental parameters such as detector geometry and shielding and the use of a low-volume, high resolution detector could improve this result by a factor of 10. Results of some investigations are presented, and applications of the method are discussed. The method is useful to determine fluorine in coal, teeth, water, vegetation, and other environmental samples. The advantages of the technique are that minimal sample preparation is required and that very small amounts of material may be analyzed. (Author abstract modified)

68944

Kellner, K. H. and J. Landbrecht

THE STATE-WIDE AIR QUALITY MONITORING SYSTEM IN BAVARIA. (Das lugthygienische Landesueberwachungssystem Bayern (LUEB)). Text in German. Gesundh.-Ingr., 95(10):297-301, 1974.

The air quality monitoring grid which existed in Bavaria was only partially automated. It comprised 27 measuring stations taking emission measurements of sulfur dioxide and partially also of carbon monoxide and the oxides of nitrogen. This measurement grid is now being expanded to a total number of eighty measuring stations and one data processing and evaluating station. In a first expansion phase 14 stations and a computer center will be added for operation in July 1974. The total system shall be completed by 1977. Costs are estimated to reach $5 million. In its final version the system will measure 24 parameters, the pollutants SO2, hydrogen sulfide, CO, nitric oxide, nitrogen dioxide, hydrocarbons, hydrogen chloride, hydrogen fluoride, ozone, the dust concentration and dust fall, meteorological parameters such as wind direction and velocity, air temperature, humidity, pressure, global radiation, precipitation with pH value, noise, radioactivity, electrostatic field, and short- term pressure fluctuations.

69152

Parts, Leo, John V. Pustinger, William D. Ross, Arthur D. Snyder, Henry H. S. Yu, Robert E. Sievers, and Joseph J. Brooks

AN ASSESSMENT OF INSTRUMENTATION AND MONITORING NEEDS FOR SIGNIFICANT AIR POLLUTANTS REMITTED BY AIR FORCE OPERATIONS AND RECOMMENDATIONS FOR FUTURE RESEARCH ON ANALYSIS OF POLLUTANTS. Monsanto Research Corp., Dayton, Ohio, Air Force Contract F33615-72-C-1304, Program Element 70230407, Rept. ARL 74-0015, 184p., Feb. 1974. 372 refs. NTIS, DDC: AD 778938

Air pollution monitoring needs of the Air Force are considered in terms of presently used instrumentation and the development of new techniques to meet specific requirements. Recommendations regarding instrument development are given for the following areas of pollution monitoring: volatile aircraft emissions (carbon monoxide, nitrogen oxides, hydrocarbons, exhaust odors); particulate aircraft emissions (particle size distribution, smoke number, mass emission, optical transmission); emissions related to missile storage facilities and missile test and launching sites (hydrogen chloride, hydrogen fluoride, hydrazine, nitrogen oxides); metallic element emission sources; herbicide incineration emissions; and ambient air measurements. General recommendations are given for areas where fundamental research is vitally important.

69174

Yanagisawa, Saburo

MECHANICAL ANALYSIS METHOD FOR AIR POLLUTANTS AND ITS TREND. (Taiki osen bushitsuo no kiki bunseki hoho to doko). Text in Japanese. Sangyo Kogai (Ind. Public Nuisance), 10(9):1-3, Sept. 1974. 8 refs.

The Agency of Industrial Science and Technology, Department of Equipment Standards has sponsored for the last 4 yr, with an annual budget of approximately $50,000, research on various types of continuous analysis equipment to be utilized by the Japanese Industrial Standards. The research had been conducted by the Industrial Pollution Control Association and various equipment manufacturers. This equipment includes continuous analyzers for sulfur oxides, carbon monoxide, nitrogen oxides, suspended particulates, stack gas SOx, hydrocarbons in the air, chlorine, oxidant, hydrogen fluoride, bad odors (hydrogen sulfide, ammonia), stack gas NOx, aldehydes, and hydrogen chloride. The first three have already been passed as JIS equipment, and the rest are under examination. Absorption spectrophotometry is widely used in Japan for single element measurement for its superior color selectivity. Electropotentiometry is used for NOx and CO. The ion electrode method is under consideration for JIS for its superior selectivity for specific ions. Among the dry methods, nondispersive infrared spectrometry is widely used; more recently, ultraviolet absorption spectrometry has been adopted for NOx analysis. The acidic rain that created physical effects this year for the first time in Japan has occurred in Europe since 1958, and acid generating substance was added as an air pollutant at the ISO Geneva Conference in 1972. The titration analyzer using a pH meter (developed in France) is widely used to measure acidity.

69526

Kaaijk, J.

DETERMINATION OF FLUORIDES IN THE ATMOSPHERE (FINAL REPORT). (De bepaling van fluoriden in de atmosfeer (eindrapport)). Text in Dutch. TNO, Haag (Netherlands), Chemisch Lab., Rept. 1973-22, 22p., Nov. 1973. 3 refs. NTIS: N74-25656

The further development and the resulting prototype of an automatic fluoride analyzer for continuous monitoring of atmospheric fluorides are described. It was possible to reduce the water loss due to evaporation during sampling by cooling the air to be released by means of Peltier coolers. For the measurement of the gaseous fluoride concentrations, particulate fluorides with aerodynamic diameters over 1 micron are separated by means of a miniature cyclone at an efficiency of 98%. The results of atmospheric fluoride measurements carried out with the automatic analyzer were in good agreement with those obtained by means of impregnated filters. Factors influencing the calibration curves, such as temperature and time, were studied.

69668

Jesenak, V., Magdi M. Naoum, and J. Tolgyessy

RADIO-RELEASE DETERMINATION OF HYDROGEN FLUORIDE IN AIR USING RADIOACTIVE KRYPTONATE OF SILICA. Radiochem. Radioanal. Lett. 13(3):199-205, 1973. 6 refs.

Radioactive kryptonate of silica is suggested for the determination of hydrogen fluoride concentration in air. Kryptonated discs of silica were allowed to react with different concentrations of HF in air. The results were linear within the 2-10 ppm concentration range, and were in fair agreement with theoretical assumptions. (Autho abstract)

69675

Kaaijk, Joke

AN ATMOSPHERIC HYDROGEN FLUORIDE MONITOR. Preprint, Chemical Lab. TNO, Rijswijk (Netherlands), 8p., 1970 (?). 3 refs.

A sampling and analytical technique for measuring hydrogen fluoride is described. Gaseous fluorides are separated from particulate matter in a miniature cyclone. The gaseous fluorides are collected in a buffer solution which circulates continuously in the measuring cell. A fluoride electrode and a reference electrode are fixed in the measuring cell. The fluoride electrode responds to free fluoride ions. The potential developed by the fluoride electrode against the reference electrode is a logarithmic function of the fluoride ion concentration in the solution, if the measurements are carried out in a buffer solution in order to avoid variations in the pH and the ionic strength in the solution and to unbind fluoride of complexing ions. The fluoride ion concentration is measured potentiometrically during the sampling period of 24 hr. In this way it is possible to determine 24-hour averages of the atmospheric HF concentration and within this period short-term averages can be measured. The monitor can measure HF concentrations in the range 0.05-15 micrograms/cu m. The calibration and testing of the device are described. The technique can be used to measue HF in stack gases by shortening the cycle period and can also measure sulfide, chloride, cyanide, and ammonia if a suitable ion selective electrode and sampling solution is used.

69765

Lee Robert E., Jr. and Howard Crist

TRACE ANALYSIS IN SOURCE TESTING. California Air Resources Board; California Univ., Berkeley, Dept. of Mechanical Engineering; and California State Dept. of Public Health, Air and Industrial Hygiene Lab., Conf. Methods Air Pollut. Ind. Hyg. Studies, 13th, Berkeley, Calif., 1972, 8p. (Oct. 30-31.)

To determine the environmental impact from trace element emissions, the trace element composition of fuels and particulates collected with the Environmental Protection Agency source sample train was determined. The simultaneous multielement analyses most frequently used were optical emission spectrography, spark source mass spectrometry, and neutron activation. These techniques were supported by other trace analysis methods including anodic stripping voltametry, atomic absorption, conductometric titrations, ion specific electrode methods, and wet chemistry. The advantages and disadvantages of these methods, precision of data, and findings to date are summarized. Considerable information can be gained relatively inexpensively if the industrial feed material, such as ore or coal, is first analyzed before a source test is initiated. Such an analysis is helpful in determining the need or scope of a source test. More measurements are needed of the size distribution of particles in various sources, especially as a function of the trace element composition. The validity of the results is being tested by conducting interlaboratory comparisons on source emission samples. Valuable information is also gained on analytical methodology and equivalency where several techniques are used to analyze the samples. A recent example of this type of activity is illustrated by the determination of fluoride by four laboratories using four different techniques in measurement of the samples.

70638

Sato, K. and M. Hoshino

SAMPLING OF FLUORIDES IN STACK GAS WITH LIME TREATED FILTER PAPER METHOD. (Arukari roshi o

mochiiru endo haigasu-chu no fukkabutsu no sanpuringu ni tsuite). Text in Japanese. Taiki Osen Kenkyu (J. Japan. Soc. Air Pollution), 9(2):436, Nov. 1974. (Presented at the National Air Pollution Research Conference, 15th, Chiba, Japan, Nov. 6-8, 1974, Paper 287.)

A filter paper holder consisting of a heating thermocouple and two layers of filter paper, a teflon filter paper, and an alkaline filter paper, was used for fluoride sampling. The filter paper was pretreated with a 10% sodium carbonate solution and dried. The sampling velocity was 10 l/min, and the filter paper flow rate was 0.35 l/sq cm/min. The filter papers were then immersed in 25 ml of sodium citrate buffer solution for 30-60 min, and the fluoride was determined by a fluoride ion electrode. More than 99% of the fluoride was collected.

70686

Pollution Atmospherique par Residus Organiques et Mineraux Grenoble (France), Study Group

SAMPLING AND ANALYTICAL METHODS FOR AIR POLLUTANTS. (Methodes de prelevement et d analyse de polluants atmospheriques). Text in French. Bull. Inform. Sci. Tech. Comm. Energ. At. (Fr.), no. 191:7-29, April 1974. 6 refs.

Sampling and analytical methods for air pollutants are described. Gaseous air pollutants are most often sampled through bubblers with adequate absorbent liquid at efficiencies of up to 85%. Organic vapors can be concentrated on gas chromatographic columns under cryogenic conditions. Particulate matter can be separated on filters or by the electrostatic method. An automatic sequential sampler can separate gases and vapors either in a bubbler or on a column. Another dust sampler is able to sample dust quantities of up to 50 mg/day without granulometric separation, and with granulometric separation from 1 micron upward. Sulfur dioxide is determined by a spectrocolorimetric method, using West-Gaeke s reagent, while nitrogen oxides are determined by Saltzmann s reagent. The methyl orange method used for the determination of chlorine has a sensitivity of 1 microgram/cu m. Hydrofluoric acid, and soluble chlorides can be determined by means of ion-specific electrodes at a sensitivity of 0.1 microgram/cu m. Organic vapors are determined best by a combination of a gas chromatograph and a mass spectrometer, using molecular sieves as an interface. Colorimeters for SO2 and NOx vapors, chemiluminescent instruments for ozone and nitrogen oxides, infrared analyzers for carbon monoxide, fluorescence and potentiometric analyzers for SO2, and flame ionization detectors for hydrocarbons are commercially available.

71044

Yamaki, Naoomi

TECHNIQUES OF ATMOSPHERIC POLLUTION PREVENTION MEASUREMENT. (Taiki osen keisoku gijutsu). Text in Japanese. Sangyo Kogai Boshi Gijutsu (Ind. Pollut. Control Tech.), 1974:33-36, June 1974.

Measurement methods for gaseous pollutants and suspended particulates are reviewed along with a discussion of the preparation of standard gases. Automatic methods for sulfur dioxide and nitrogen oxides are being developed. The Electrotechnical Lab is studying the electromagnetic determination and identification of minor components of air using electron impact ionization. The Institute of Environmental Pollution and Resources is studying the measurement of hydrofluoric acid, hydrogen chloride, carbon monoxide, nitrogen oxides, and hydrogen cyanide. It was recently found that almost complete collection of mercaptan and sulfite is possible by the use of a large excess of silver nitrate and that with 6 N HCl decomposition of the collected substances is possible to the extent of 94-100% for mercaptans, 99-100% for monosulfite, and 98% for bisulfite. These findings are being applied to determination by combined chromatography-mass spectral analysis. Dilution methods for standard gases are discussed.

71231

American Society for Testing and Materials, Philadelphia, Pa.

TENTATIVE METHOD OF ANALYSIS FOR FLUORIDE CONTENT OF THE ATMOSPHERE AND PLANT TISSUES (SEMIAUTOMATED METHOD). Book ASTM Stand., no. 26:754-767, 1974. 9 refs.

A semiautomated colorimetric procedure for the analysis of total fluoride in the atmosphere and other media (e.g., plant tissue) is described. The method incorporates microdistillation of the sample and may be applied to any fluoride-containing solution where standards of identical composition are carried through the same sample preparation procedures and are proven to provide quantitative recovery when analyzed by the semiautomated system. Atmospheric samples must be brought into solution and must fall within the calibration range of the instrument. Samples are analyzed sequentially with standard solutions which have a composition similar to the samples or with standards which provide the same recovery of fluoride. In either case, the method must be confirmed by a manual procedure. The semiautomated procedure involves pumping a sample slurry or solution and sulfuric acid into a polytetrafluoroethylene coil of a microdistillation device maintained at 170 C. A stream of air carries the acidified sample through the coil to a fractionation column. Fluoride and water vapor are condensed and pumped continuously from a distillate collector. Spent acid and solids are continuously removed as waste. Distillate is mixed continuously with a colorimetric reagent (alizarin fluorine blue-lanthanum) and passed through the flow cell of a recording colorimeter. The normal range of analysis is 0.1-4.0 micrograms F/ml. normal range of analysis is 0.1-4.0 micrograms F/ml.

71232

American Society for Testing and Materials, Philadelphia, Pa.

TENTATIVE METHODS FOR ANALYSIS FOR FLUORIDE CONTENT OF THE ATMOSPHERE AND PLANT TISSUES (MANUAL PROCEDURES). Book ASTM Stand., no. 26:735-753, 1974. 31 refs.

Titrimetric, spectrophotometric, and potentiometric methods for the manual determination of fluorides in the atmosphere and other media (e.g., plant tissue) are outlined. Direct titration of fluoride with standard thorium nitrate solution can accommodate from 10 to 0.05 mg of fluoride in the total sample. Back titration modifications can measure from 50 to about 5 micrograms fluoride in the total sample. Direct titration can also be used for the lower ranges if photometric end point detection is employed. For the spectrophotometric detection of fluoride, both Zirconium-Eriochrome Cyanine R and Zirconium-SPADNS reagents obey Beer s law over the range from 0.000-1.40 micrograms of fluoride/ml with a detection limit of 0.02 microgram/ml. A Lanthanum-Alizarin Complexone procedure for the lower range covers from 0.00 to 0.5 microgram of fluoride/ml with a detection limit of approximately 0.015 microgram/ml. The spectrophotometric methods are temperature sensitive, and absorbances must be read within + or - 2 C of the temperature at which the respective calibration curve is established. The potentiometric determination of fluoride (inorganic) is achieved by diluting the alkaline sample solution containing atmospheric fluoride 1 + or - with a combined buffer (ionic strength adjuster and complexing agent) ad-

justed to pH 5.9-6.1 prior to analysis with a fluoride ion selective electrode. The potential corresponding to the fluoride ion concentration is measured in millivolts. The recommended range for analysis of air samples is between 0.1 and 10 micrograms/ml of fluoride in solution.

71244

American Society for Testing and Materials, Philadelphia, Pa.

TENTATIVE METHOD FOR SEPARATION AND COLLECTION OF PARTICULATE AND GASEOUS FLUORIDES IN THE ATMOSPHERE (SODIUM BICARBONATE- COATED GLASS TUBE AND A PARTICULATE FILTER METHOD). Book ASTM Stand., no. 26:728-734, 1974. 6 refs.

A method for the separation and collection of particulate and gaseous fluorides in the atmosphere is described. The method employs a sodium bicarbonate-coated glass tube and a membrane filter and is capable of collecting 2-500 micrograms of gaseous fluoride over a 12-hour sampling period at a sampling rate of 14.2 l/min (0.2-50 micrograms/cu m). The lower limit of detection is considered as twice the standard deviation of the monthly arithmetic mean blank value. The method involves removing gaseous fluorides from the air stream by reaction with sodium bicarbonate coated on the inside wall of a borosilicate glass tube. Particulate fluorides are collected on a filter following the tube. The fluoride collected on the tube is eluted with water or buffer and analyzed for fluoride, and the particulates collected by the filter are eluted with acid and then analyzed for fluoride. The results are reported as micrograms of gaseous fluoride and micrograms of particulate fluoride per cubic meter of air at 21 C and 760 torr pressure. Possible interferences include acid aerosols or gases which are capable of neutralizing or acidifying the bicarbonate coating and phosphates or metals such as aluminum which are capable of interfering with the subsequent analysis. Regarding the method s precision, the root mean square difference of duplicate bicarbonate-coated tubes within the range from 0.5- 3.3 micrograms fluoride/cu m is 0.051 microgram fluoride/cu m. Recovery of hydrogen fluoride is better than 95% for amounts of fluoride up to about 40 micrograms and for sampling periods of 15-120 min. Data on particulate fluoride are insufficient to establish recovery under field conditions.

71245

American Society for Testing and Materials, Philadelphia, Pa.

TENTATIVE METHOD FOR CONTINUOUS SEPARATION AND COLLECTION OF PARTICULATE AND WATER-SOLUBLE GASEOUS FLUORIDES IN THE ATMOSPHERE (FILTER AND IMPINGER METHOD). Book ASTM Stand., no. 26:721-727, 1974. 6 refs.

A method for the continuous separation and collection of particulate and water-soluble gaseous fluorides in the atmosphere is described. The method utilizes a chemically treated filter and an impinger. Sampling rate may vary from 14.2 l/min for 24 hr to 28.3 l/min for 3 hr, depending on the atmospheric fluoride concentration. The procedure involves drawing air through an air inlet tube for passage through an acid-treated prefilter which removes particulates. The stream is then drawn through an impinger for the removal of water-soluble fluorides. The prefilter and impinger solutions are subsequently analyzed by potentiometric or photometric methods. Possible interferences include particulate metallic salts, phosphates, and metals such as aluminum. The precision and accuracy of the method are not yet established.

72015

American Society for Testing and Materials, Philadelphia, Pa.

TENTATIVE METHOD FOR AUTOMATED SEPARATION AND COLLECTION OF PARTICULATE AND ACIDIC GASEOUS FLUORIDE IN THE ATMOSPHERE (DOUBLE PAPER TAPE SAMPLER METHOD). Book ASTM Stand., no. 26: 715-720, 1974. 14 refs.

A tentative method for the automated separation and collection of particulate and acidic gaseous fluoride in the atmosphere by means of a double paper tape sampler is described. Air is drawn through an air inlet tube and is first passed through an acid-treated prefilter paper tape to remove any particulates which may contain fluoride and then through an alkali-treated paper tape to remove acidic fluoride gases. Exhaust air is filtered through soda lime-glass wool, and the cleaned air is used to pressurize the front compartment to prevent fluoride contamination of the paper tapes from the ambient air. At the end of the preset sampling period (several minutes to 3 hr), the vacuum pump is automatically turned off, and the tapes are indexed. The paper tapes are removed from the sampler and analyzed by potentiometric or photometric methods. Possible interferences include: particulate metallic salts, acid aerosols or gases, and phosphates or metals such as aluminum. The relative standard deviation of hydrogen fluoride determination is about 16% for the 1-3 micrograms/cu m range and about 5% for the 12-45 micrograms/cu m range. Recoveries of hydrogen fluoride are better than 95% with amounts of fluorides of up to 40 micrograms and at sampling periods of 15-120 min. The precision and accuracy of particulate fluoride determinations are not yet established.

72017

Prinz, B.

APPROACHES AND RESULTS OF AN EFFECT MONITORING-PROGRAMME IN THE STATE NORDRHEIN WESTPHALIA. World Meteorological Organization and World Health Organization, Geneva (Switzerland), World Meteorol. Organ./World Health Organ. Tech. Conf. Observ. Measurement Atmos. Pollut., Helsink, Finland, 1973, p. 223-235. 1974. 10 refs. (July 30-Aug. 4, Paper 368.)

An effect monitoring program was conducted in Nordrhein Westphalia to measure the effect of pollutants on a set of indicators. Three groups of indicators were applied: effects observations by use of exposed lichens, wood, and metal patterns representing the biological and technical part of the environment; uptake of pollutants by the biosphere by use of standardized grass cultures; and uptake of pollutants by standardized materials by use of massflow proportional measuring devices. The mortality rate of the lichen area was determined in percent of the undamaged area at the beginning of the exposure. The mortality rates range from 0 to 38% comparable with 0% at a site in nonindustrial area and 84% at a site in Duisburg, both outside the surveyed region. Grass cultures were exposed under standardized conditions to sulfur, fluorine, chlorine, lead, zinc, and cadmium. All sites showed a considerable and widespread amount of S uptake. The correlation coefficients between S uptake and the uptake of the other five compounds reflect the emission situation in the area. The correlations and partial correlations between sulfur dioxide concentrations, IRMA-data (mass stream proportional uptake of a pollutant), and uptake of S by grass are more significant for the effect-related uptake by grass than the concentration values.

73127

Dee, L.. A., H. H. Martens, and J. T. Nakamura

EVALUATION OF SOLID SORBENTS FOR SAMPLING SO2, HCL, AND HF FROM STATIONARY SOURCES (FINAL REPORT). United States Air Force, Edwards, Calif., Rocket Propulsion Lab., Environmental Protection Agency Proj. EPA 000CX, Rept. AFRPL-TR-74-54, FY 73, 11p., Aug. 1974. 6 refs. NTIS, DDC: AD-784813

Various solid sorbents were evaluated for the sampling of sulfur dioxide, hydrogen chloride, hydrogen fluoride, and silicon tetrafluoride from stationary sources. Lead oxide did not absorb HF or SiF4, though it did appear to absorb HCl and SO2 quantitatively; however, the problems associated with extraction and subsequent analysis of the corresponding anions are insurmountable at present. Lithium carbonate is a useful sorbent for HCl and HF, though less complicated carbonate sorbents need to be first evaluated. Manganese dioxide also absorbs SO2, but further efforts are needed to develop a more specific trace sulfate determination method.

73349

Mori, M., H. Morita, and Y. Okabe

ON THE HF GAS MONITOR BY FLUORIDE ELECTRODE. (Ion denkyoku-ho ni yoru haigasu-chu HF sokutei no tsuite). Text in Japanese. Taiki Osen Kenkyu (J. Japan. Soc. Air Pollution), 9(2):437, Nov. 1974. (Presented at the National Air Pollution Research Conference, Chiba, Japan, Nov. 6-8, 1974, Paper 28II.)

A hydrogen fluoride monitor having a glass absorption chamber in which absorbent was sprayed into the sample gas is described. A pH buffer for fluoride determination was supplied as an absorbent at 1 ml/min, and a sample gas containing HF was introduced at a flow rate of 4 l/min. The resulting absorbent was pumped to a detector cell, and the fluoride concentration was determined by the fluoride ion electrode method. Results obtained from five samples of the same type were compared to those obtained by chemical and lathanum-alizarin complexone (JIS K 0105) methods, and correlation coefficients of 0.994-0.996 were obtained. The monitor was usable in the ranges of 0-5 ppm and 0-2 ppm, and the standard deviation was about + or - 3%.

73471

Vol berg, N. S. and T. A. Kuz mina

DETERMINATION OF HYDROGEN FLUORIDE IN ATMOSPHERE. (Opredeleniye ftoristogo vodoroda v atmosfere s otborom prob na tverdyy sorbent). Text in Russian. Tr. Gl. Geofiz. Observ, no. 293:78-82, 1973. 9 refs.

A method for sampling gaseous hydrogen fluoride on solid sorbent for subsequent photometric determination by the attenuation of the coloration of a zirconium-xylenol range complex is described. Glass granules of 1 to 2 mm in size, treated with 0.2% alcohol solution of potassium chloride, are used as solid sorbent either in a wet or dry state. The rate of sampling amounts to 3 l/min for up to 20 min for hydrogen fluoride concentrations not greater than 0.2 mg/cu m. The adsorbed hydrogen fluoride is quantitatively desorbed by a small amount of water. The solid sorbent is placed in a glass tube 5 mm in diameter.

74221

Nakamura, K.

MEASUREMENT TECHNOLOGY AT AN OUTBREAKING POINT OF AIR POLLUTION. (Hasseigen ni okeru sokutei gijutsu). Text in Japanese. Preprint, Japan Society of Civil Engineering, p. 31-46, 1972. (Presented at the Japan Society of Civil Engineering, Lecture Meeting, Tokyo, May 23-24, 1972.)

Measurement methods for determining the total emission of gaseous pollutants from fixed sources are described. Total sulfur oxides are determined by the neutralization method, the Arusenazo III method, and the barium chloranilate method. Waste gases containing nitrogen dioxide, hydrogen chloride and chlorine cannot be analyzed for their total SOx by the neutralization method. Sulfur dioxide can be analyzed by using a sulfamate solution as the absorbent and titrating with iodine. Fluoride can be analyzed using the lanthanum-alizarin complexone method by measuring the absorbance of the resulting complex near 620 nm. Chlorine can be analyzed by passing the gas into ortho-tolidine solution which results in the formation of a yellow solution (absorbance near 435 nm). Hydrogen chloride can be analyzed by a spectrophotometric method (mercuric thiocyanate method) or a volumetric method (silver nitrate method and neutralization method). A correction is required if chlorine coexists. Total nitrogen oxides can be analyzed by the naphthylethylenediamine method. The continuous determination of the above substances by conductivity, infrared analysis, potentiometry, ultraviolet analysis, chemiluminescence, and gas chromatography is also briefly discussed.

74234

Weinstein, L. H. and R. H. Mandl

THE SEPARATION AND COLLECTION OF GASEOUS AND PARTICULATE FLUORIDES. VDI (Ver. Deut. Ingr.) Ber., no. 164:53-70, 1971. 20 refs.

Laboratory and field tests of three methods for the separation and collection of gaseous and particulate fluorides were conducted. The three sampling procedures evaluated comprised: bicarbonate-coated tubes with citric acid-treated Acropor AN-800 membrane filters fitted to either the inlet or the outlet ends of the tubes, a double-tape sampler with a citric acid-treated Whatman No. 52 prefilter tape and a Whatman No. 4 alkali- treated tape, and duplicate filter holders each containing citric acid-treated Acropor AN-800 membrane as a prefilter and an alkali-treated Whatman No. 41 paper to collect gaseous fluoride. The results for gaseous fluoride collected by the three devices were reasonably close, although the tape sampler gave results considerably higher than the others on 3 days. The tape sampler also showed wide diurnal fluctuations in fluoride concentration which was highest during warm periods when fluoride desorbed from chamber surfaces. The bicarbonate-coated tubes were sensitive to humidity; moisture condensation resulted in partial or complete removal of the bicarbonate coating from the tubes.

74346

PRESENT STATUS AND FUTURE OF ANALYTICAL INSTRUMENT FOR POLLUTION. (Kogai keisoku kiki no genjo to tenbo). Text in Japanese. Puranto Enjinia (Plant Eng.), 7(1):31-34, Jan. 1975.

A general discussion of the present status of the Japanese analytical instrument industry, measurement method policies and conditions for standardization is presented. The total production of air pollution instrumentation increased from 6743 units for a total cost of about $22,500 in 1971 to 54,247 units costing $60,000 in 1974. The instruments included those for the detection of carbon monoxide, carbon dioxide, sulfur dioxide, nitrogen oxides, total hydrocarbons, hydrogen

fluoride, chlorine and chlorinated compounds, particulates, automotive exhaust gases, oxidants, atmospheric metals, and odors. The Japan Electric Instrument Industry Association began establishing examination standard models for air pollution instruments in 1972. Standard models of polarography, spectrophotometry and gas chromatography were scheduled for completion in 1974.

74354

Liyv, Reet, R. Ott, P. Luyga, and Valentina Pikkov

CUMULATIVE MEASUREMENT OF SULFUR DIOXIDE AND FLUORIDES IN AMBIENT AIR. (Kumulyativnoye opredeleniye dvuokisi sery i ftoridov v atmosferom vozdukhe). Text in Russian. Izv. Akad. Nauk Est. SSR, Khim. Geol., 23(3):208-213, 1974. 17 refs.

A method for the cumulative sampling and determination of ambient sulfur dioxide and fluorides in a given sample is described. Sulfur dioxide and fluorides are sampled by means of potassium carbonate-impregnated filter papers exposed at 4 m altitude. Sulfates are determined by precipitation with benzidine hydrochloride and subsequent alkaline titration in the presence of phenolphthalein. Fluorides in the same sample are determined colorimetrically at 618 nm by means of a lanthanum alizarine complex.

74471

Shizuoka Prefectural Government

ENVIRONMENTAL POLLUTION MONITORING SYSTEM. (Kogai Kanshi taisei). Text in Japanese. In: Environmental White Paper, 1974, p. 300-303, 1975.

For efficient air pollution control, the accurate and expeditious measurement of pollution is essential. In Shizuoka Prefecture, the concentrations of sulfur oxides, suspended particulates, oxidant, nitrogen oxides, hydrocarbons, carbon monoxide, hydrogen fluoride, and hydrogen sulfide have been constantly monitored. The list of automatic measurement instruments used as of Dec. 1973 includes 66 automatic SOx analyzers, 26 NOx analyzers, 5 HC analyzers, 7 CO analyzers, 10 HF analyzers, and 10 H2S analyzers. Microanalyzers such as the X-ray microanalyzer for the measurement of micro-amounts of pollutans (such as polychlorinated biphenyls and data processing systems were acquired in 1973. A list of measurement instruments used as of Dec. 1973 for air, water, noise, vibration, and other pollution measurement is also given.

74942

Inagaki, K.

AIR POLLUTION MEASUREMENT METHODS. (Taiki nodo no sokutei ho). Text in Japanese. Kagaku Kojo (Chem. Factory), 19(8):24-34, Aug. 1975. 12 refs.

Sampling and measurement methods of air pollution are discussed. The JIS methods for the analysis of air pollutants (absorbent in parentheses) include: ammonia: titration and indophenol methods (0.5 W/V% boric acid); total sulfur oxides: neutralization (3% hydrogen peroxide) and arsenazo III methods (ammonium sulfamate + ammonium sulfate, pH 5.4); sulfur dioxide: iodine titration method (ammonium sulfamate + ammonium sulfate, pH 5.4); nitrogen oxides: naphthylethyleneamine method (0.1 N ammonia water); total NOx: phenolsulfonic acid method (diluted sulfuric acid + H2O2); nitrogen dioxide: naphthylethyleneamine method (0.1 N sodium hydroxide); fluoride: lanthanide alizarin complexon and thorium nitrate-neothorin methods (0.1 N NaOH); chlorine: o-toluidine method (0.01 W/V% o-toluidine hydrochloric acid solution (pH 1.6)); HCl: mercuric thiocyanate, silver nitrate, and neutralization methods (0.1 N NaOH); hydrogen sulfide: iodine titration and methylene blue methods (zinc ammonium complex salt solution); and hydrogen cyanide: silver nitrate titration and pyridine-pyrazolone methods (2 W/V% NaOH). Infrared spectrometry is used for continuous analyses of SO2, carbon monoxide, nitrogen oxide and NH3, while conductivity and spectrophotometric methods are used for continuous analyses of SO2, chlorine gas, HCl, NH3 and NOx.

75058

Burch, D. E. and D. A. Gryvnak

INFRARED GAS FILTER CORRELATION INSTRUMENT FOR IN-SITU MEASUREMENT OF GASEOUS POLLUTANTS (FINAL REPORT). Philco-Ford Corp., Newport Beach, Calif., Aeronutronic Div., Environmental Protection Agency Contract 68-02-0575, Program Element 1AA010, Work Unit 14, ROAP 26AAP, Rept. EPA-650/2-74-094, Rept. U6121, 64p., Dec. 1974. 15 refs. NTIS: PB 239467/AS

An infrared gas filter correlation instrument for measuring the concentrations of carbon monoxide, nitric oxide, sulfur dioxide, hydrogen chloride, and hydrogen fluoride in the effluent of stationary sources is described. An infrared beam is directed across the stack to a retroreflector and back so that the instantaneous average concentration is measured continuously without disturbing the constituents of the effluent. A small, removable, fixed-position grating monochromator acts as a unique optical filter that passes narrow spectral intervals that are centered at wavelengths where the gas to be detected absorbs. One grating monochromator is used for CO and NO, another for SO2 and HCl, and a third for HF. The useful ranges of concentration times path length, in atm cm, over which the gas can be measured are: 0.005-0.04 for NO; 0.0013-0.15 for CO; 0.001-4.0 for SO2; 0.0003-0.2 for HCl; and 0.0001-0.02 for HF. Discrimination against other gases in the effluent is excellent. Field tests of the instrument on the smokestack of a coal-burning power plant were satisfactory. Minor problems encountered included: the accumulation of dirt on the windows, binding of the window shutters, and difficulties in changing the detector without exposing it to the sunlight. (Author abstract modified)

75339

Greifer, Bernard and John K. Taylor

POLLUTANT ANALYSIS COST SURVEY (FINAL REPORT). Dept. of Commerce, Washington, D. C., National Bureau of Standards, Environmental Protection Agency Interagency Agreement IAG 215, Program Element 1AB013, ROAP 21ADD-BJ, Rept. EPA-650/2-74-125, 208p., Dec. 1974. 772 refs. NTIS: PB 241991/AS

The capabilities and costs of various analytical methods for trace element determinations in fly ash, coal, oil, ores, minerals, metals, alloys, organometallics, incinerator particulates, slurry streams, and sedimentation process feeds are summarized. Analytical methods covered include nuclear activation, mass spectrometry, X-ray fluorescence, electron and ion microprobe spectrometry, atomic absorption spectrophotometry, emission spectrophotometry, polarography, and potentiometry. These methods are evaluated in terms of their capability for determining trace amounts (less than 100 ppm) of mercury, beryllium, cadmium, arsenic, vanadium, manganese, nickel, antimony, chromium, zinc, copper, lead, selenium, boron, fluorides, lithium, silver, tin, iron, strontium, sodium, potassium, calcium, silicon, magnesium, uranium, and thorium. A selected bibliography and a review of the Standard Reference Materials available for environmental analysis are also presented.

76030

Kuz mina, T. A.

DETERMINATION OF VOLATILE FLUORIDES EMITTED BY ALUMINUM PLANTS. In: Atmospheric Diffusion and Air Pollution Problems, Voprosy atmosfernoy diffuzii i zagryaznenlya vozdukha, Leningrad, Gidrometeoizdat Press, 1974, 225p. 5 refs. Translated from Russian, 5p.

The efficiency of sorption tubes that trap silicon tetrafluoride and hydrogen fluoride for measurement was tested with a range of known concentrations, and at different rates of drawing air through the tubes. One tube containing a 1 ml layer of solid sorbent absorbed almost all the SiF4 and HF at 10 l/min. A Richter device was used to measure fluorides that slipped through the tube. The influence of several atmospheric cations that enter the absorbing solution during measurement of the fluorides in the solution was also tested. No effect on the measurement of fluorides was found for a 100-fold excess of calcium, cadmium, lead, zinc, or chromiun cations, or for a 10-fold excess of iron cations. Silicon tetrafluoride is emitted in significant quantities with HF in some industries. Its generation for lab study is complicated because it tends to hydrolyze and to be sorbed on glass. A device that solves this problem and is effective for generating microconcentrations of SiF4 in air is described.

76212

Habel, Karl

MEASURING TECHNIQUES FOR DETERMINATION OF FLUORINE CONTENT OF AIR AND STACK GASES. (Derzeitiger Stand der Messtechnik zur Bestimmung des Fluorogehaltes in Immisionen und Emissionen). Text in German. Arch. Eisenhuettenw., 44(9):697-702, 1973. 7 refs.

Recent measuring techniques for and problems involved in the measurement of gaseous and particulate fluorine concentrations in the air and in stack gases are reviewed. It is possible to determine the total fluorine content in the air by sampling with impinger or sorption tube filled with sodium carbonate-coated silver spheres. These methods do not permit, however, the separation of gaseous and particulate fluorine. Gaseous fluorine can be sampled in such sorption tubes after the air is passed through a dust separator. Gaseous and particulate fluorine can be separated in a more or less satisfactory manner by the membrane filter method using a heated filter, combined with impinger or sorption tube. Filtration through silica wool is suitable for the sampling of gaseous fluorine compounds in stack gases in a concentration range of up to 200 mg/cu m. There is no reliable procedure for the exact separation of gaseous and solid fluorine compounds. Gaseous fluorine compounds can be determined at an accuracy of 10-15%, while solid fluorine compounds can be determined on the basis of the dust measurement.

77427

Hermann, Peter and Walter Rode

SEMI-AUTOMATIC DETERMINATION OF THE FLUORINE CONCENTRATION IN SAMPLES FROM GAS IMMISSION MEASUREMENTS AND FROM PYROHYDROLYSIS OF SOLID MATERIALS. (Halbautomatische Bestimmung des Fluorgehaltes [illegible]ben aus Gasemissionsmessungen und in Feststoffaufsch[illegible]u). Text in German. Staub, Reinhaltung Luft, 35(8):298 [illegible], Aug. 1975. 14 refs.

The fluoride contents of solutions received from emission measurement and from pyrohydrolysis of solid materials were determined by semiautomated analysis using three ion-specific electrodes. The time required is 18 min for each sample. The standard deviation is s equals 0.04 mg/l at fluoride concentrations of 1 to 2 mg/l and s equals 0.02 mg for a sample containing 0.05 to 1 mg fluoride. Interferences by aluminum and magnesium ions were not found at concentrations up to 1 mol/l. The detectable limit of the method is 1.7 times 10 to the -6th power mol/l or 0.03 mg.

77492

Tsukamoto, H., M. Ohashi, and T. Sakai

SIMPLIFIED COLORIMETRIC DETERMINATION OF FLUORINE IN URINE AND PARTICULATE FLUORIDES IN ATMOSPHERE BY MEANS OF DIRECT DIFFUSION. (Chokusetsu kakusan ni yoru kichi ryushi jo fukka- butsu narabini nyo-chu fusso no kanben hishoku sokutei ho). Text in Japanese. Tetsudo Rodo Kagaku (Science of Railroad Labor), no. 28:65-71, 1974. 11 refs.

A simplified colorimetric method for the determination of fluorine in urine is described. The mean recovery of fluoride by the proposed method is 99.1% when fluorine is added to the urine. The standard value of fluorine content in urine by this method is 0.83 mg/l and 57.2 micrograms/hr. The upper limit of the 95% region is 3.51 mg/l and 299.5 micrograms/hr. This method is also successfully applied to the determination of fluorides in the atmosphere after the collection of particulates on a filter made of paper or glass fiber. In this case, the use of a glass fiber hinders the diffusion of fluorine. However, the accuracy of determination is not lost if a correction is made by preparing a calibration curve. Examinations of urine from workers at a factory where welding is done indicate safe concentrations of fluorine in the welding area.

78426

Hermann, Peter

THE CHEMICAL ANALYSIS OF SMALL FLUORIDE CONTENTS IN SOLIDS AND IN CASE OF EMISSION MEASUREMENTS. (Zur chemischen Analyse geringer Fluorgehalte in Feststoffen und bei Emissions-messungen). Text in German. Z. Ziegel-, Steinzeug- Ind., vol. 4:142-145, 1975. 11 refs.

Fusion processes for the determination of small fluoride contents in solids are compared. Alkaline oxidizing fusion with subsequent distillation and the pyrohydrolytic fusion process produce the same results. The photometric determination of fluoride ions in distillates from these solid fusions is made using alizarin complexon with a fluoride ion sensitive electrode fitted into a semi-automatic type of equipment. Adsorption solutions from emission measurements are similarly determined according to the two analytical processes. The equal validity of the two methods of analysis is demonstrated by a random sampling of 30 solutions. Detailed instructions are given on the pyrohydrolytic fusion of solids and also on measurement with fluoride ion sensitive electrodes, including semi-automatic operation.

79003

Greifer, B., B. C. Cadoff, J. Wing, and J. K. Taylor

DEVELOPMENT OF SOLID STATE SAMPLERS FOR WORK ATMOSPHERES (SEMIANNUAL REPORT). National Bureau of Standards, Washington, D. C., National Institute for Occupational Safety and Health Proj. 3104150, Rept. NBSIR 74-527, 28p., June 1974. 57 refs. NTIS: COM-74-11720

Evaluations of the efficiency of solid sorbents for collecting trace quantities of hydrogen fluoride, phosphine, hydrogen cyanide, chlorine, and fluorine in occupational atmospheres are presented. Sodium acetate is a very efficient sorbent for hydrogen fluoride, and its solubility in water is highly advantageous for subsequent HF determination by ion selective

electrode. Potassium permanganate impregnated silica gel sorbs phosphine effectively, and Ascarite appears suitable for sorbing HCN. Work on chlorine and fluorine systems is to be undertaken in the future. (Author abstract modified)

79032

PAROM (Pollution Atmospherique par Residus Organiques et Mineraux) Study Group of C.E.N., Grenoble, France

METHODS OF SAMPLING AND ANALYSIS OF ATMOSPHERIC POLLUTANTS. (Methodes de prelevements et d analyse de polluants atmospheriques). Text in French. Bull. Inform. Sci. Tech. Commis. Energ. At. (Fr.), no. 191:7-29, 1974. 6 refs.

Existing air pollutant sampling and analytical methods developed by PAROM, Grenoble, France, are described. Gaseous pollutants are sampled most commonly by bubbling them through a reagent or absorbent solution, while organic vapors are adsorbed on a chromatographic adsorbent layer at a very low temperature. Particulate matter is sampled by filtration or by electrostatic precipitation, the latter technique permitting non-destructive sampling and granulometric separation for analysis. Certain gaseous air pollutants, such as sulfur dioxide, nitrous gases, and chlorine are determined commonly by the spectrocolorimetric method, while hydrogen fluoride and soluble chlorides are determined by means of ion-specific electrodes. For the analysis of particulate matter, the organic fraction is extracted with solvents by ultrasonic technique, after which the organic fraction is separated by thin-layer or liquid chromatography for determination by a combination of gas chromatography and mass spectrometry, while the mineral fraction is analyzed by atomic absorption or X-ray fluorescence. Organic vapors are determined most efficiently by a combination of gas chromatography and mass spectrometry. An instrument for the field measurement of gaseous fluorine by means of a ion-specific electrode at a sensitivity of 0.1 microgram/cu m, and a similar instrument for chlorine determination at 1 microgram/cu m sensitivity have been developed.

79389

Pella, P. A., E. E. Hughes, and J. K. Taylor

DEVELOPMENT OF GAS-BLENDING SYSTEMS FOR CALIBRATION: APPLICATION TO HYDROGEN FLUORIDE, ARSINE AND PHOSGENE IN AIR. Am. Ind. Hyg. Assoc. J., 36(1):755-759, Oct. 1975. 9 refs.

Gas blending systems for calibrating analytical monitoring devices were developed and applied to hydrogen fluoride, arsine, and phosgene in air. A high concentration of the standardized gas mixture is dynamically diluted with air or nitrogen to obtain the desired concentration levels. The standardized gas mixtures are measured periodically to determine any changes with time in the concentrations. Gas mixtures prepared by dilution were measured and compared with values calculated from the gas blending data. Hydrogen fluoride in the standardized mixture and in the gas mixtures prepared by dilution was determined by potentiometry employing a fluoride ion specific electrode. Arsine and phosgene gas mixtures are determined by spectrophometric methods. Phosgene in a standardized gas mixture is measured by coulometric titration at constant current. These gas mixtures are measured in the concentration ranges from 1-60 ppm for HF, from 0.02-0.2 ppm for arsine, and from 0.05-5.0 ppm for phosgene. These concentrations represent from 0.5 to 5 times the threshold limit value for these gases.

79835

Gomenyuk, A. S., V. P. Zharov, D. D. Ogurok, E. A. Ryabov, O. A. Tumanov, and V. O. Shaydurov

OPTICAL - ACOUSTIC DETECTION OF SMALL CONCENTRATIONS OF HYDROGEN FLUORIDE, NITRIC OXIDE AND CARBON DIOXIDE MOLECULES IN GASES BY IRRADIATION WITH HYDROGEN FLUORIDE PULSED LASER. (Optiko- akusticheskie detektirovanie malikh kontcentrtcy molekul ftoristogo vodoroda, okisi azota i dvuokisi ugleroda v gasakh izluchenkem impul snogo lazera na ftoristom vodorode). Text in Russian. Kvantovaya Elektron., no. 8:1805-1811. 1974. 11 refs.

Experimental results on detection of micro-concentrations of hydrogen fluoride, nitric oxide, and carbon dioxide molecules in air and in oxides are given. These results were obtained by an optical-acoustic method making use of a hydrogen fluoride pulsed laser. In the pulsed regime the laser gives substantially more energy than in the continuous regime. This property of the pulsed laser allows detection of the minimal concentration of impurity in the air (1 ppm). The system was absolutely calibrated on a standard mixture. The results on detection of HF, NO, and CO2 molecules and relationships between energy and coefficient of absorption and between output signal and pressure of pure CO2 are given. Continuously tunable lasers should be used to increase sensitivity and selectivity.

79842

Ludwig, C. B. and M. Griggs

APPLICATION OF REMOTE MONITORING TECHNIQUES IN AIR ENFORCEMENT. Preprint, Science Applications, Inc., La Jolla, Calif. 4p., 1975. (Presented at the Environmental Sensing and Assessment Conference, Las Vegas, Nev., Sept. 14-19, 1975.)

The application of remote measurement techniques to air enforcement monitoring is discussed. Several modes of remote detection can be employed in enforcement monitoring: direct observation of a plume by passive or active monitors, perimeter monitoring from van-based platforms or airborne platforms, and horizontal active long-path monitoring. Air pollutants that are amenable to remote monitoring in the immediate or near-term time frame include particulates, sulfur dioxide, nitrogen dioxide, carbon monoxide, light hydrocarbons, hydrogen chloride, hydrogen fluoride, ammonia, nitrogen oxides, hydrogen sulfide, nitric acid, ozone, and vinyl chloride. Remote monitoring in the long-term time frame shows potential for the measurement of heavy hydrocarbons, sulfur oxides, certain specific trace elements, and chlorinated hydrocarbons. The most promising laser systems for near-term operational use are differential absorption, lidar, and the laser Doppler velocimeter.

79843

Barker, D. B., J. N. Brooks, A. Goldman, J. J. Kosters, D. G. Murcray, F. H. Murcray, J. Van Allen, and W. J. Williams

REMOTE SENSING OF TRACE CONSTITUENTS FROM ATMOSPHERIC INFRARED EMISSIONS AND ABSORPTION SPECTRA. Preprint, Denver Univ., Colo., Dept. of Physics and Astronomy, 7p., 1975. 14 refs. (Presented at the Environmental Sensing and Assessment Conference, Las Vegas, Nev., Sept. 14-19, 1975.)

Atmospheric infrared emission and absorption spectra obtained from aircraft and balloon-born spectrometers are presented. Mixing ratio versus altitude profiles are derived for nitric acid, difluorodichloromethane, trichlorofluoromethane, and hydrogen fluoride for altitudes up to 25 km. Freon 12

(CF2Cl2) shows two sharp spectral features at 921.9/cm and at 923.2/cm in addition to broad band absorption. The CF2Cl2 band occurs in a stratospheric window between minor absorption by HNO3 and carbon dioxide bands. Nitric acid column density is shown to increase from the equator to high latitudes, with the latitudinal variation in the northern hemisphere differing from that in the southern hemisphere. Calculated absorption spectra for hydrogen chloride, ammonia and sulfur dioxide are presented and demonstrate the feasibility of using remote sensing for the detection of these compounds also.

80103

Egan, Harold

CHEMICAL ANALYSIS AND ENVIRONMENTAL QUALITY. Chem. Ind. (London), no. 19:814-820, Oct. 4, 1975. 44 refs.

The chemical analysis of the atmospheric environment is discussed. Field tests are available for specific industrial hazards designed to indicate levels of exposure approaching the threshold limit value. The threshold limit value in industrial situations for sulfur dioxide is 5 ppm by volume. Total sulfate is determined by the sensitive tetrachloromercurate method used for short period sampling. Rugged portable electro optic devices based on ultraviolet absorption are available for SO2 estimations. Particulate material is collected in a standard deposit gauge. Separate measurements of combustible matter, ash, tar, and dissolved ions are made. Smoke is assessed as units of equivalent standard smoke using a reflectometer to measure the darkness of a stain collected on a filter. Other standard methods are available for the measurement of sulfuric acid, total sulfate, ammonium salts, sodium chloride, polycyclic aromatic hydrocarbons, trace metals, total fluoride, hydrogen sulfide, ammonia, nitrogen oxides, carbon monoxide, ozone, and methane.

80227

Yamane, Tsuneko

DETECTION OF HALOGENS AND SULFUR BY MEANS OF LASER MICROSPECTRAL ANALYSIS. (Rezo hakko-bunko bunseki ni yoru harogen genso oyobi iou no kenshutsu). Text in Japanese. Bunko Kenkyu (Res. Spectroscop.), 22(5):321, 1973.

The emission spectroscopy of fluorine, chlorine, bromine, iodine, and sulfur was studied using a Nd-doped glass laser and a ruby laser as the excitation source. The emission lines were photographically measured using high purity potassium fluoride, barium fluoride, lithium fluoride, potassium chloride, sodium chloride, potassium iodide, sodium iodide, thallium iodide, or sulfur powder; the spectral region measured was 2300 to 5000 A. No emission could be detected when the laser was used as the only excitation method, however, with the addition of spark excitation using carbon electrodes, several emission lines of each element could be observed. The emission intensities increased under the discharge condition, producing a spherical spark plasma. The number of observed emission lines was small for fluorine and chlorine; however, many emission lines were detected for bromine, iodine, and sulfur. The emission intensity of fluorine and chlorine tended to be weaker than that of bromine, iodine, and sulfur. The width of the observed spectral lines for these elements was broader than for iron and silicon. The 0.6% thallium iodide in graphite powder could be detected.

80259

Williams, David T. and Charles S. Palm

EVALUATION OF SECOND DERIVATIVE SPECTROSCOPY FOR MONITORING TOXIC AIR POLLUTANTS (FINAL REPORT). Florida Univ., Gainesville, Aerospace Medical Div. Contract F41609-73-C-0011, Rept. SAM-TR-74-19, 124p., Sept. 1974. 21 refs. NTIS, DDC: AD/A-000 949

The feasibility of using second derivative absorption spectrometry to analyze toxic gases and vapors was investigated. Test data from scans of 28 different substances are presented for the 2000 to 7000 A spectral region. Substances measured included acetone, ammonia, aniline, benzaldehyde, benzene, dimethylamine, formaldehyde, hydrazine, monomethylamine, nitric oxide, nitrogen dioxide (nitrogen tetroxide), oxygen, ozone, pyridine, sulfur dioxide, toluene, trimethylamine, unsym-dimethylhydrazine, (UDMH), xylene, carbon monoxide, chlorine, chlorine trifluoride, dry and wet diborane, ethyl nitrate, ethylene oxide, fluorine, and monomethylhydrazine (MMH). All but the last eight produced signatures which are quantified in tables of instrument sensitivity values. A special effort was expended in the study of the hydrazines. Hydrazine itself was found detectable in the pure form and via its air reaction product ammonia. Monomethylhydrazine is undetectable in thee pure form, but it is readily detectable via reaction products with air; UDMH is detectable in pure form. The second derivative spectrometer is unlikely to be made hand portable because of the required high detection sensitivities. The design of a fixed base installation of somewhat higher sensitivity is relatively simple to produce. Theory and characteristics of a second derivative spectrometer are discussed. (Author abstract modified)

80423

Sandia Labs., Albuquerque, N. Mex., Environmental Health Dept.

FLUORIDES AND HYDROGEN FLUORIDE IN AIR AND WATER. In: Manual of Analytical Methods for the Environmental Health Laboratory. Atomic Energy Commission Contract AT (29-1)-789, p. 23-25, June 1975. 2 refs. NTIS: SAND75-0014

A colorimetric method for the determination of fluorides and hydrogen fluoride in air and water is described. The method is based on the reaction between fluoride and a zirconium-dye lake. The color of the dye lake becomes progressively lighter as the amount of fluoride increases and can be measured at 570 nm. Interfering ions include: aluminum, chloride, iron, hexametaphosphate, phosphate, sulfate, and alkalinity as calcium carbonate. It is necessary to distill the water sample to remove most interferences. Since the interferences are neither linear nor additive, mathematical compensation can not be employed for corrections. The temperature of the samples and standards must be the same to obtain correct results.

80495

Hoppesch, J. P. and R. C. Domingo

PICOGRAM DETECTION OF SULFUR HEXAFLUORIDE BY HIGH PRESSURE CHARGE EXCHANGE MASS SPECTROMETRY. Anal. Letters, 8(11):839-848, 1975. 4 refs.

A method was investigated for the determination of sulfur hexafluoride by high pressure charge exchange mass spectrometry at levels as low as 3 times 10 to the -12 power g. It employs specific ion detection in combination with gas chromatography to insure a high degree of specificity. The method was used to measure ten 1 ml samples of air known to contain 20 ppb SF6. The standard deviation was 4.08%.

80573

Gourdon, F.

MEASUREMENT AND AUTOMATIC CONTROL OF AIR POLLUTION. (Mesure et controle automatique de la pollution atmospherique). Text in French. Sci. Munic. Rev. Eau, (70(6):249-258, June 1975.

Systems and apparatus for manual and automatic sampling and analysis of air pollutants, especially within air quality monitoring networks, are described. An Air Quality Sampler developed in the U. S. uses special plastic bags made of aluminum-coated Mylar or Tedlar for air sampling. The standardized strong acidity method is used for the determination of sulfur dioxide in hydrogen peroxide solution of pH 4.5. This method is equally applicable as a manual or automatic method. When used as an automatic method, the solution pH value is stabilized by the addition of sodium tetraborate. According to a new manual method, sulfur dioxide, nitrogen dioxide, hydrochloric acid, hydrogen sulfide, and fluorine are absorbed on a dry absorbent impregnated with an adequate reagent. Nitric oxide is determined by a preliminary oxidation to NO2 in ultraviolet light. Nitrogen oxides can also be measured by chemiluminescent method, especially by the oxidation of NO into NO2 by means of ozone. Sulfur dioxide can be measured by automatic flame photometry.

80935

Kubono, Ryuichi and Hiroyoshi Morita

MEASURING METHOD AND APPLIED EXAMPLES OF HYDROGEN FLUORIDE AND HYDROGEN CHLORIDE GASES. (Fukka suiso gasu, enkasuiso gasu no sokuteiho to oyorei). Text in Japanese. PPM (Japan), 6(11):67-78, 1975. 3 refs.

Analytic methods for hydrogen fluoride gas from industries such as aluminum refineries, superphosphate manufacturers, ceramic industries and steel industries, and for hydrogen chloride gas from waste incineration plants, amino-acid plants, polyvinyl chloride manufacturers, metal pickling plants, and general chemical plants are reviewed. The prevalent Lanthanium-Alizarine Complexion method (ALC method) and ion electrode method for hydrogen fluoride, and various chemical analytic methods and continuous analytic methods for hydrogen chloride are discussed. An automatic analyzer for monitoring concentrations of hydrogen fluoride, model GNE-21 of the Denki Keiki Co., Ltd., is introduced and its design structure and performance are discussed. A continuous analyzer for hydrogen chloride, model GSF-11, by the same company is introduced, and its analytic principle, design structure, analytic conditions, and the volume measured as compared to the volume measured by chemical analytic methods are discussed.

81357

DeCormis, L.

FLUORATED ATMOSPHERIC POLLUTION. (La pollution atmospherique fluoree). Text in French. Pollut. Atmos (Paris), 17(65):10-13, Jan.-March 1975.

Analytical methods currently used to identify and measure the rate of atmospheric pollution by the fluorated by-products are reviewed. Statistical methods express cumulative pollution throughout a determined period through an impregnated support. The unit adopted is arbitrary (microgram/d sq m/day). Dynamic methods measure a mean pollution (in microgram/cu m) throughout the sampling period which can vary from a few hours to a few days according to the intensity of the pollution. There is no technique to separate with certainty gaseous fluorated by-products (hydrogen fluoride) and particle fluorides, whose size is usually submicronic.

81439

Anderson, Paul L.

DEVELOPMENT OF A CENTRIFUGE FOR SOURCE SAMPLING TO DETERMINE PARTICLE SIZE DISTRIBUTION. Environ. Sci. Technol., 10(2):145-150, Feb. 1976. 6 refs.

A small centrifuge source-aerosol sampler with a spectral calibration range of from 0.16-3 micron is described. The sampler includes multi-orifice cascade impactor plants ahead of the centrifuge to process coarse particulates. The centrifuge is thermally protected and small enough to be used for some in-stack sampling applications. The application of the sampler to the collection of aerosols before and after a fluid bed reactor baghouse on the experimental aluminum reduction cell is described. The fluid alumina bed appears to be an efficient collector of fine fume particles as well as hydrogen fluoride. Coarse fines (1-10 micron) predominately penetrate the baghouse as opposed to fines less than 1 micron in size. (Author abstract modified)

82273

IMMISSION MEASUREMENT. MEASUREMENT OF FLUORINE ION CONCENTRATION. (Messung von Immissionen. Messung der Fluor-Ionen-Konzentration). Text in German. VDI (Ver. Deut. Ingr.) Richtlinien, no. 2452:1-7, Dec. 1963. 8 refs.

A method is described for the measurement of fluoride ions using a sodium hydroxide-filled impinger; fluoride is then removed from the NaOH solution by steam distillation with sulfuric acid. Photometric analysis of the distillate for fluoride then follows. The solutions are described. This method detects hydrogen fluoride and silicon tetrafluoride, as well as fluoride ions in the air. (Author abstract modified)

82552

Ottaway, J. M. and D. C. Hough

CARBON FURNACE ATOMIC ABSORPTION ANALYSIS OF ATMOSPHERIC PARTICULATES. Proc. Anal. Div. Chem. Soc., 12(12):319-321, Dec. 1975. 1 ref.

A carbon furnace atomic absorption technique for the analysis of atmospheric particulates was developed and applied in a steelworks. Fifteen elements were monitored: arsenic, beryllium, cadmium, cobalt, chromium, copper, fluorine, mercury, manganese, molybdenum, nickel, lead, tin, vanadium, and zinc. The main sources of the dust emissions were the sinter plant, the open hearth steel making furnace, and the basic oxygen steel making furnaces. A high volume turbine blower mounted on the back of a van was used to collect the atmospheric particulate samples from various locations at the works. Particulates were collected from up to 17 cu m of air in 30 min and sample masses varying between 0.6 and 0.7 mg were collected on Whatman No. 41 filter papers. These were dissolved in nitric and perchloric acids. Acceptable results were obtained for Zn, Fe, Mn, Pb, and Cu.

82650

Lancour, James B. and Victor [illegible]. Hanson

GLASS FURNACE EMISSION TESTING FOR CONDENSABLE BATCH MATERIALS AND TRACE METALS. Preprint, Toledo Univ., Toledo, Ohio and George D. Clayton and Associates, Inc., Southfield, Mich., 26p., 1975. 11 refs. (Presented

at the Engineering Foundation Conference, Evaluation of Air Pollution Emissions of Stationary Sources, Pacific Grove, Calif., March 31-April 4, 1975.)

Sampling and analytical methods that can be used to determine filterable and total fractions of boron, chlorides, fluorides, sulfur oxides, and trace metals in emissions from glass melting furnaces are reviewed. Considerations dealing with the selection of materials for nozzle and probe construction, the selection of filter media, probe decomposition and chemical corrosion, and the formation of glass deposits on the sampling nozzle under various environmental conditions are discussed. Analytical methods reviewed include: atomic absorption spectrometry, chemical methods, spectrophotometric methods, gravimetric procedures, emission spectrometry, flame photometry, and X-ray methods.

83442

Bennett, Roy L., Jack Wagman, and Kenneth T. Knapp

THE APPLICATION OF A MULTICHANNEL FIXED AND SEQUENTIAL SPECTROMETER SYSTEM TO THE ANALYSIS OF AIR POLLUTION PARTICULATE SAMPLES FROM SOURCE EMISSIONS AND AMBIENT AIR. Preprint, Environmental Protection Agency, Research Triangle Park, N. C., Environmental Research Center, 10p., 1975. 2 refs.

A Siemens multichannel wavelength X-ray fluorescence spectrometer that is specially adapted to the needs of the Environmental Protection Agency for the rapid analysis of particulate samples is described. The system consists of 16 fixed-wavelength spectrometers which are optimized for 16 preselected elements and a computer operated scanning channel which is used to determine additional elements that might be desired on a given sample. A minicomputer operates the instrument and sample changer and also processes the data. The fixed monochromators in the spectrometer are capable of analyzing for chromium, lead, manganese, arsenic, mercury, bromine, phosphorus, silicon, cadmium, aluminum, sulfur, sodium, fluorine, magnesium, potassium, and chlorine. The detection limit for most elements is 30 nanograms/sq cm or less. The high resolution of the crystal spectrometers permits analyses of air pollution and source emission samples which contain several dozen elements over a wide range of concentrations. (Author abstract modified)

83495

Liberti, Arnaldo

MODERN METHODS FOR AIR POLLUTION MONITORING. Pure Appl. Chem., 44(3):519-534, 1975. 16 refs.

The monitoring of basic pollutants (sulfur oxides, nitrogen oxides, carbon monoxide, oxidants, hydrocarbons, and particulate matter) to determine the air quality of a certain area is described. Specific methods for monitoring sulfur oxides include: acidimetry, conductimetry, colorimetry, potentiometry and coulometry, and flame photometry. Nitrogen oxides are measured using colorimetry, coulometry, chemiluminescence, and fluorescence. Oxidants are monitored using colorimetry, electrochemistry, chemiluminescence, and ultraviolet photometry. Methods for monitoring CO include: titrimetry, colorimetry, non-dispersive infrared analysis, catalytic analysis, electrolysis, and gas chromatography. Hydrocarbons are measured by hydrogen flame ionization detector, while some fluorides are determined by the classical colorimetric procedure. Mass measurements of particulates are made by weighing. The performance of air monitoring by static, mechanized, or automatic devices in point sensors and by remote and long path sensors is discussed. (Author abstract modified)

83592

Baker, Bertsil B., Jr.

MEASURING TRACE IMPURITIES IN AIR BY INFRARED SPECTROSCOPY AT 20 METERS PATH AND 10 ATMOSPHERES PRESSURE. Am. Ind. Hyg. Assoc. J., 35(11):735-740, Nov. 1974. (Presented at the American Industrial Hygiene Conference, Minneapolis, Minn., June 1-6, 1975.)

The measurement of trace impurities in air by infrared spectroscopy at 20 meters path and 10 atmospheres pressure is described. The use of a new type of drying device achieves considerable selectivity in the removal of water from ambient air. The sample is compressed to 10 atm, without the separation of liquid water that would otherwise occur. Use of the higher pressure in a 20 meter gas cell permits the infrared spectral detection of many compounds of toxicological interest in the 0.05 to 1 ppm range. These include the air pollutants carbon monoxide, sulfur dioxide, hydrogen sulfide, and carbon disulfide, and classes of pollutants such as chlorinated hydrocarbons, fluorinated hydrocarbons, acid fluorides, esters, aldehydes, ethers, ketones, nitriles, amines alcohols, and acids.

84175

Aburamoto, Yukio and Kazuyasu Shimada

PROBLEM AND ITS SOLUTION IN SAMPLING BY THE ATP METHOD. (ATP ho ni yoru sanpuringu no mondaiten to sono kairyo). Text in Japanese. Taiki Osen Kenkyu (J. Japan. Soc. Air Pollution), 10(4):287, 1975. (Presented at the National Air Pollution Research Conference, 16th, Niigata, Japan, Nov. 5-7, 1975, Paper 25.)

The loss of sodium fluoride from filter paper used in the adenosine triphosphate method was studied. Sodium fluoride was added to a filter paper to give 300 microgram fluoride, which was then exposed to the atmosphere for 1 month. At the end of the exposure, the fluoride remaining on the filter was 45 to 74% less than the initial amount. When 100 microgram fluoride was added to a filter paper, there was 4 to 47% less than the initial fluoride amount after 1 month exposure. The loss of fluoride compounds from the filter paper can be neglected during exposure. Three cylindrical filter papers were put together, and the lower two cylinders were wrapped with a vinyl cover, which was then exposed in the atmosphere near an aluminum refinery. After a 1-month exposure, the fluoride on each cylindrical filter paper was determined. The fluoride detected from the bottom cylinder was less than 20 microgram/50 sq cm paper/month. The middle cylinder had 38 to 78 microgram, and the top cylinder had 194 to 378 microgram. Thus, wrapping the filter paper with a vinyl cover prevented the loss of fluoride compounds.

84182

Sato, Kenji, Mitsuru Hoshino, Yoshimatsu Odate, Masayoshi Minakami, Fusamune Suzuki, and Shuji Iitoyo

SAMPLING OF FLUORIDES IN STACK GAS WITH THE LIME-TREATED FILTER PAPER METHOD, II. (Arukari roshi o mochiiru endo haigasu chu no fukkabutsu no sanpuringu ni tsuite, sono 2). Text in Japanese. Taiki Osen Kenkyu (J. Japan. Soc. Air Pollution), 10(4):303, 1975. (Presented at the National Air Pollution Research Conference, 16th, Niigata, Japan, Nov. 5-7, 1975, Paper 45.)

The use of alkaline filter paper for the collection of fluoride compounds in flue gas was studied. Toyo filter paper No. 51A, 40 mm diameter, was treated with 5% sodium carbonate solution and dried. In a filter holder, two of the alkaline filter papers prepared were placed in series after a teflon filter to remove dust, then flue gas was sucked through the holder. The

collection efficiency for fluoride compounds by two alkaline filter papers were more than 90%. The alkaline filter paper method was compared with the impinger method. Both methods were used to collect fluoride compounds from the same flue gas. The alkaline filter paper method collected more fluoride compounds than the impinger method. With the same flue gas flow rate of 1.7 l/min, the alkaline filter paper method gave 0.19 mg fluoride/N cu m, while the impinger method gave 0.12 mg/N cu m.

84209

Nakao, Shozo and Ikuo Hirose

ANALYTICAL METHODS FOR SEPARATION OF FLUORIDE FROM FLUORIDE COMPLEX IN ATMOSPHERIC SAMPLES USING GEL-CHROMATOGRAPHY. (Taiki chu no fukkabutsu oyobi fusso-saku kagobutsu no gerukuromatoguraphi ni yoru bunri bunsekiho to sono oyo). Text in Japanese. Taiki Osen Kenkyu (J. Japan. Soc. Air Pollution), 10(4):306, 1975. (Presented at the National Air Pollution Research Conference, 16th, Niigata, Nov. 5-7, 1975, Paper 48.)

A separation method for fluoride ion compounds and hexafluorosilicate (IV) complex compounds by gel-chromatography was studied. The column materials examined were Sephadex-G10, ECTEOLA, alumina, and an ion exchange resin. No separation could be obtained by the latter two column materials, but separation could be achieved by the former two. The fluoride ion compound in 0.05 N sodium chloride solution was not absorbed with Sephadex-G10 but the hexafluorosilicate complex compound in the same solution was absorbed with this column material and could be eluted with 0.5 N sodium chloride solution. The fluoride ion compound in water was not absorbed with ECTEOLA but the hexafluorosilicate complex in the same solution was adsorbed with this column material and could be eluted with 0.05 N sodium chloride solution. The method was applied to analyze atmospheric fluoride compounds. Of the fluoride compounds, 1290 were fluoride ion and the remaining 88% were fluoride complex.

84213

Kobayashi, Yoshitaka, Masahiro Hori, and Akira Iino

MEASUREMENT OF TRACE FLUORIDE IN ATMOSPHERE BY THE ALKALINE FILTER PAPER METHOD. (Arukair roshiho ni yoru taikichu fukka butsu no sokutei ni tsuite). Text in Japanese. Taiki Osen Kenkyu (J. Japan. Soc. Air Pollution), 10(4):304, 1975. (Presented at the National Air Pollution Research Conference, 16th, Niigata, Nov. 5-7, 1975, Paper 46.)

An analytical technique for gaseous fluorides by the alkali filter method with the lanthanum alizanine complex method was studied. A filter paper was pre-treated with 30% potassium carbonate solution, on which fluoride was collected. The fluoride collected on the filter paper was heat-extracted with water and the measurement was done using the lanthanum-alizanine complex method. A linear fluoride calibration curve was obtained up to 2.0 microgram fluoride/ml from the pH 5 solution. No interference with the absorbance was observed for potassium ion, carbonate ion, chloride ion, nitrite ion, ferric oxide, or aluminum oxide. However, the presence of sulfate ion produced a suspension in the solution which increased the absorbance measured. This sulfate ion interference could be eliminated if the suspending compounds were removed by a centrifugal separation before the measurement of the absorbance. The technique was applied to measure the fluoride pollution in an industrial area. The filter paper was exposed for 1 month in the atmosphere, and the fluoride level was determined. Up to 20 microgram fluoride/day/100 sq cm was detected from the air. This analytical result agreed with the result obtained by a conventional method which was also used to measure the fluoride pollution at the area.

84214

Ohmichi, Sadao and Hikotaro Ida

COLLECTION AND DETERMINATION OF GASEOUS AND PARTICULATE FLUORIDES IN AMBIENT AIR. (Taikichu no ryushijo, gasujo fukkabutsu no hoshu to bunsekiho). Text in Japanese. Taiki Osen Kenkyu (J. Japan. Soc. Air Pollution), 10(4):305, 1975. (Presented at the National Air Pollution Research Conference, 16th, Niigata, Nov. 5-7, 1975, Paper 47.)

The collection and analysis of gaseous fluoride compounds was studied. The collection method studied was a filter paper which was pre-treated with 1 to 10% sodium carbonate solution. The prepared filter paper was used to trap hydrogen fluoride gas. The HF collected on the filter paper was extracted with water, and was measured by the ion electrode method and the lanthanum-alizanine complex method. The detection limit of HF by both methods was 0.25 microliter HF. The HF trapping efficiency of the filter papers treated with 1% and 2% sodium carbonate solution was 89.6 to 96.8% and 90.7 to 94.9%, respectively. When the filter paper was pretreated with more than the concentration of 5% sodium carbonate solution, it affected the absorbance in the lanthanum-alizanine complex method. When the filter paper was pretreated with 10% sodium formate instead of sodium carbonate, it did not affect the absorbance; moreover, the filter paper gave better HF trapping efficiency, ranging between 96.5 and 98.1%.

84463

Thomas, S. H., E. D. Switala, and J. B. Lancour

AMBIENT MONITORING OF FLUORIDES. Preprint, Air Pollution Control Assoc., Pittsburgh, Pa., 12p., 1975. 6 refs. (Presented at the Air Pollution Control Association Southern Section Annual Meeting, 6th, Nashville, Tenn., Sept. 18-19, 1975.)

The development of a program for the ambient monitoring of fluorides at a fiberglass facility is described. The program is required to demonstrate compliance with Tennessee regulations governing gaseous fluorides. Included in the program are economic and technical factors: cost/benefit analysis; qualifications of personnel conducting the program; number and location of monitoring stations; design of sampling stations; number size, and frequency of samples to be taken; duration of sampling program; and sampling and analytical procedures used during the program.

84471

Nucciotti, F. and G. Simonini

AIR POLLUTANT SAMPLING BY MEANS OF POTASSIUM CARBONATE FILTERS EXPOSED AT A SHELTERED SITE. (Echantillonage de polluants atmospheriques par filtre au K2CO3 exposes dans abris meteorologiques). Text in French. World Meteorol Organ./World Health Organ., Tech. Conf. Observ. Measurement Atmos. Pollut., Helsinki, Finland, 1973, p. 363-369. 9 refs. NTIS: N75-11476-540

A simple and inexpensive method for air sampling for the subsequent chemical analysis of air pollutants by means of potassium carbonate filters is described. Air is sampled by means of exposed cellulose filters imbued with potassium carbonate solution and dried. The filters are exposed at a sheltered site for up to 30 days, and substantially less in areas with low overall pollution levels. Following exposure, the filters are

subjected to chemical analysis of air pollutants, such as oxides of nitrogen and sulfur, hydrogen sulfide, fluorine compounds, and practically all acid compounds. The sampling method is especially suitable for the determination of averaged concentrations, and even in areas with low air pollution levels.

84499

Smith, Walter

COLLECTION EFFICIENCY STUDY OF THE PROPOSED METHOD 13 SAMPLING TRAIN (FINAL REPORT). Entropy Environmentalists, Inc., Research Triangle Park, N. C., Environmental Protection Agency Contract 68-02-1792, Program Element 1AA010, Rept. EPA-600/2-75-052, 28p., Sept. 1975.

The collection efficiency of the proposed Method 13 sampling train and the accuracy and precision of the two Method 13 analytical techniques for determining fluorides were investigated. A collection efficiency of 99% for gaseous hydrogen fluoride was obtained for fluoride concentrations ranging from 6-118 ppm and at sampling rates of 3/4 and 1 cu ft/min. The fluoride specific ion electrode method of fluoride analysis was more accurate and precise than the Spadns Zirconium Lake colorimetric method, with the latter showing a positive bias. (Author abstract modified)

84660

Japan Environmental Agency

GUIDELINE ON MEASUREMENT METHODS OF ENVIRONMENTAL ATMOSPHERE. (Kankyo taiki chosa soutei hohoto shishin). Text in Japanese. Kankocho Kogai Senmon Shiryo (Public Nuisance Gaz.), 10(4): 33-53, July 1975.

A revised edition of the Guideline on measurement methods of environmental atmosphere was published in 1973. The 1974 edition gives improved methods based on further experience. The committee to investigate measurement methods was established at the Environmental Protection Agency. Efforts have been made to unify analytical methods, but no completely satisfactory result has been reached. Therefore, at some research institutes which have had extensive experience in analysis, if it is not necessary to conform to the unified measurement methods described here. Methods, frequency, and period of sampling referred to are also only general standards, to be revised in accordance with the anticipated concentration in the atmosphere. The pollutants covered are sulfur dioxide, carbon monoxide, hydrocarbon, oxidant, ozone, dust, aerosol, fluorine (gaseous and particulates), nitrogen oxides, gaseous halogens, ammonia, mercury, cyanides, polychlorinated biphenyls, benzopyrene, hydrogen sulfide), and soot. General rules for measurement are also given. Reagents used must be better than Japanese Industrial Standard special class quality. Air volume is based upon 20 C. The error of flowmeters is around 2%.

D. AIR QUALITY MEASUREMENTS

01872

W.J. Martin

A FLUORIDE AIR POLLUTION MONITORING PROGRAMME. Preprint. (Presented at the 58th Annual Meeting, Air Pollution Control Association, Toronto, Canada, June 20-24, 1965, Paper 65-31.)

This report describes the fluoride monitoring programme that was developed in 1962 when cyanamid of Canada Limited constructed a granular phosphate plant at Niagara Falls, Canada. Article points out that an effective fluoride monitoring programme must have the following objectives: (1) Continuous monitoring of particulate and gaseous fluoride emitted to the atmosphre, (2) Vegetation and soil sampling for fluoride within a 5 mile radius of the source, (3) Observation of significant meteorological conditions, (4) Continuous monitoring of aqueous fluorides discharged from the plant, and (5) Personnel monitoring for fluoride.

06809

L. K. Smith

FUME EXPOSURES FROM WELDING WITH LOW HYDROGEN ELECTRODES. Ann. Occupational Hyg. (London) 10 (2), 113-21 (Apr. 1967).

Studies were made of the exposures of arc welders using low hydrogen electrodes under a variety of welding conditions. The welding locations are described and classified according to the degree of confinement. Fluoride and total fume determinations were made on samples of welding fume collected beneath the welding handshield. The range of exposures was wide for each location and the median value was selected as a more representative value than the mean. Confined locations produced the highest total fume and fluoride concentrations. Total fume values in excess of 10 mg/cu.m. were found in 75 percent of samples from confined environments, 50 percent from enclosed and 27 percent from open. Fluoride concentrations in excess of 2.5 mg/cu.m. were recorded in 35 per cent of the samples from confined spaces and 13 per cent from each of the other environments. Time-weighted exposures ranged from 1.05 to 7.9 mg/cu.m. for total fume and 0.17 to 0.88 mg/cu.m. for fluoride. (Author summary modified)

07579

Hluchan, E., Ya. Mayer, and E. Abel

ATMOSPHERIC POLLUTION BY FLUORINE COMPOUNDS IN THE NEIGHBORHOOD OF AN ALUMINUM PLANT. (Zagryaznenie atmosfery soedinenlyami ftora v okrestnostyakh alyuminievogo zavoda.) Text in Russian. Gigiena i Sanit.. 30(9), Sept. 1965. Engl. Transl. by Israel Program for Scientific Translations, Hyg. Sanit., 30(9):426-428, Sept. 1965. CFSTI: TT66-51033/3

The results of the determination of fluorine compounds in the atmosphere around an aluminum plant over a period of 6 years are given. The method used consisted of the titration of distilled samples with thorium nitrate, in the presence of the new metallochrome indicator Methylthymol Blue. Concentrations of fluorine compound in the atmosphere within a large radius of an aluminum plant varied from 0 to 1.15 mg/cu. m. The fallout from the atmosphere of solid fluorine compounds in the vicinity of the plant amounted to 4300 kg/cu.km. per year, which is almost 53 times the natural fallout of this substance over small populated areas. The area around the plant is excessively contaminated, with high fluorine concentrations in the soil, agricultural products, plants, animal surface waters, and other elements of the environment.

09590

Public Health Service, Washington, D. C., National Center for Air Pollution Control

PARKERSBURG, WEST VIRGINIA, MARIETTA, OHIO AIR POLLUTION ABATEMENT ACTIVITY. 87p., March 1967. ((38)) refs.

An investigation of air pollution in the interstate area encompassing Mariette, Ohio, Parkersburg, West Virginia, and Vienna, West Virginia was conducted. The average concentrations of suspended particulates measured in the three major population centers was in excess of 150 micrograms per cubic meter with maximum daily values in excess of 500 micrograms per cubic meter. The average value for 2-hour sulfur dioxide measurements made at three locations was approximately 0.02 part per million parts of air. At the Vienna station, however, a daily average concentration of 0.10 part of sulfur dioxide per million parts of air was exceeded 3.4 percent of the time. Short-term concentrations approached one part sulfur dioxide per million parts of air at various times. Sensitive vegetation exposed in Vienna developed injury that was attributed to the synergistic action of ozone and sulfur dioxide in low-level combination. Damage to indigenous vegetation from sulfur dioxide and fluorides was also observed. Atmospheric corrosion of ferrous metals was not abnormally high. Tarnishing of silver plate indicated, however, that the presence of gaseous sulfides is consistent with reported complaints of odor nuisance. From an inventory of emissions of sulfur oxides and particulate pollutants it is estimated that more than 123,000,000 pounds of sulfur oxides and 25,000,000 pounds of particulate pollutants are emitted each year from sources in the survey area. Approximately 85 percent of the sulfur oxide and 55 percent of the particulate matter are emitted from sources in Ohio, and 15 percent of the sulfur oxides and 45 percent of the particulate matter from sources in West Virginia. Eight point sources account for almost 98 percent of the total sulfur oxides and 94 percent of total particulate emissions. Mathematical applications of diffusion theory were used to estimate the relative contributions of specific sources.

09658

Harding, C. I.

SULFATION AND CORROSION MEASUREMENTS IN A MARINE COASTAL CITY OF FLORIDA. In: Proceedings of the International Converence on Atmospheric Emissions from Sulfate Pulping, Sanibel Island, Fla., April 28, 1966. E. R. Hendrickson (ed), Sponsored by: Public Health Service, National Council for Stream Improve- ment, and University of Florida. DeLand, Fla., E. O. Painter Printing Co., ((1966)), p. 354-357

As part of a comprehensive survey in a Marine coastal city in Florida, measurements were made of corrosion rates and sulfation rates. The location of pulp mills, power plants and static sampling stations are shown on a map. Sampling stations were located throughout the entire area of 15 miles by 15 miles. At each station, sulfation, dustfall, fluoride by limed paper, and corrosion were monitored. All stations were changed once a month. A 1000- foot television tower was located at the center of the grid. Sulfation was measured by the lead dioxide-candle method. The units which were used for expressing sulfation rate were micrograms of SO3 per square centimeter per day. Corrosion measurements were made using carbon-steel plates which were cleaned, dried and weighed, and exposed for the 30-day period. Following exposure each plate again was cleaned and reweighed. The unit of measurement for corrosion rate was milligrams of metal oxidized per square centimeter per month. In order to determine the effect of marine environment on corrosion rate, a separate series of sampling stations was located on a line through the television tower beginning at the beach front and running into town. At the waterfront 15 miles from the center of town, the corrosion rate was very high but moving back from the beach, rates dropped off rapidly to a back- ground level. The highest corrosion rates were noticed north of the T. V. tower area, in the center of the industrial area. The corrosion rate with vertical distance was also measured at the T. V. tower. These data indicate that the plumes from both the power plants and pulp mills have a corrosive influence. The background corrosion rate in this community is rather high as would be expected in a coastal city.

10619

Schneider, Willi

LONG-DURATION FLUORINE STUDIES IN AN INDUSTRIAL CONCENTRATION AREA. Staub (English translation), 28(1):17-24, Jan. 1968. 10 refs. CFSTI: TT 68-50448/1

Continuous measurements over large spaces were carried out in industrial areas to determine the fluorine content of air near Duisburg, Germany. The air samples were taken by means of apparatus which operated continuously under any weather conditions. Altogether 1,339 individual values were used for the determination. The mean value of all measurements was 1.3 micrograms F/cu m air an thus by two to three powers of ten below the Maximum Allowable Concentration value. No indications were found as to continuous or temporary fluorine emission sources. (Author's summary, modified)

13838

Macuch, P., E. Hluchan, J. Mayer, and E. Able

AIR POLLUTION BY FLUORIDE COMPOUNDS NEAR AN ALUMINUM FACTORY. Fluoride Quarterly, J. Intern. Soc. Fluoride Res., 2(1):28-32, Jan. 1969.

From 1958 to 1965, contamination near an aluminum factory in the vicinity of Bratislava, Czechoslovakia, averaged 0.14 mg F/cu cm. This average represents a fivefold increase above the maximum allowable concentration of 0.03 mg F/cu cm. The gaseous fluorides HF and SiF4 constitute 39% of the fluid values in the air near the plant as compared to 61% solids, namely CaF2, NaF, and Alf3. The proportion varies with the distance from the factory: at an area 8 to 9 km from the factory, 15% solid and 85% gaseous F compounds were present in the atmosphere. The relative increase in gaseous compounds is apparently due to sedimentation of the solid F compounds near the factory. Values of the yearly F fallout in the contaminated area were 44 to 7337 kg sq km. F values obtained for soil in the area of the factory were 135 mg/100 g (1350). This is 4 to 7 times higher than the usual F content of soil. Grass near the factory contained F values as high as 133 mg/100 g dry substances. While running surface waters showed only slightly increased F levels, standing surface waters contained as much as 10.9 mg/l. Determination of F fallout and of F content in plants and biological materials is the best means of assessing long term effects of fluoride emissions. Meteorological influences appear to be less significant in evaluating F damage. The composition of soil, the presence of F dust on plants, and the F content of flowing and ground waters are of little use in determining F damage to human, plant, and animal life.

14066

Hluchan, E., J. Mayer, and E. Abel

AMBIENT POLLUTION FROM FLUORINE COMPOUNDS IN THE NEIGHBORHOOD OF AN ALUMINUM FACTORY. (Inquinamento ambientale da composti del fluoro nelle vicinanze di una fabbrica di alluminio). Text in Italian. Med. Lavoro (Milan), 59(5):370-375, 1968.

Measurements conducted from 1958 to 1965 show that fluoride emissions from an aluminum factory near Bratislava ranged from 3.6 to 4.2 tons per day. In the zone surrounding the factory, the total concentration of fluoride in the air averaged 0.14 mg/cu m, five times the amount of the maximum allowable concentration. The gaseous fluorides HF and SiF4 constituted 39% of the total fluorides in this area, and the particulate fluorides CaF2, NaF, and AlF3 about 61%. At a distance of about 8 to 9 km, the gaseous forms were 85% of the total, and the particulates only 15%. Values up to 135 mg F/100 g were found in the soil near the factory. Grass in this area had a fluorine content as high as 135 mg/100 g dry weight. Drinking water in the area was relatively unaffected, but the pollution of marsh and stagnant waters averaged 10.9 mg/liter. The high environmental F concentrations were reflected in animals: ashes from the bones of sparrows and frogs caught near the factory contained, respectively, from 101.3 to 352.7 and 85.2 to 788 mg/100 g. The following measures are proposed to protect the health of the inhabitants of the region: limitations on the food products grown even in the least contaminated zones and on the number of persons allowed to settle in the area, clinical control of the exposed population, and a plan of development for the entire region. These measures should be implemented by technological steps to reduce the pollution caused by the factory.

17102

Morik, Jozsef

MEASUREMENT OF AIR POLLUTION IN HUNGARIAN INDUSTRIAL CENTERS. (A levego szennyezettsegenek merteke ipari telepuleseinken). Text in Hungarian. Magy. Tud. Akad. Orvosi Tud. Oszt. Kozlemen., 18(3/4):417-424, 1967.

Budapest has by far the most serious air pollution problems of any Hungarian industrial center as shown by large scale measurements over a 10-15 year period. Data is presented in the form of 7 tables, compiled both by the author and by other Hungarian authors, based on studies of air pollution in Hungarian metropolitan areas. Eleven such areas, including Budapest, almost consistently show values in excess of the legally permissible limits of dust, carbon particles, and sulfur dioxide. In some of these communities, there are also excesses of such dangerous substances as chromium, phenol, beryllium, copper, silicon, and manganese. In the industrial sectors of the big cities, in addition to soot, dust, and sulfur compounds resulting chiefly from some type of combustion, one also finds a noticeable content of ammonia, the nitrogen oxides, chlorine gas, and organic chlorine compounds such as chlorphenol. The

stench of some of these organic compounds, particularly the chlorinated hydrocarbons, is noticeable as much as 15-20 kilometers away. Measurements of fluorine pollution in the vicinity of the Varpalata aluminum plant gave figures of 0.097 mg of fluorine per cu meter at 2 km distance from the plant, and 0.67 mg at a distance of 20 meters. The permissible limit is 0.01.

17642

Tomson, N. M., Z. V. Dubrovina, and E. N. Bondareva

SANITIZATION OF ATMOSPHERIC AIR POLLUTED BY AN ALUMINUM PLANT DISCHARGES. U.S.S.R. Literature on Air Pollution and Related Occupational Diseases, vol. 8:136-140, 1963. (B. S. Levine, ed.) CFSTI: 63-11570

Air in the vicinity of a plant where aluminum oxide is electrolyzed on carbon electrodes was analyzed for dust content, fluorides, sulfur dioxide, and tars. Dust settling at 500 meters from the plant accumulated to 63 g/sq m in 30 days; at 1000 meters, to 200 g/sq m; and at 2000 meters, to 50 g/sq m. Sulfur dioxide concentrations of 6.0 mg/cu m in the plant's sanitary clearance zone were 12 times in excess of the 0.03 mg/cu m allowable limit and hydrogen fluorides were 68 times in excess of the allowable 0.3 mg/cu m limit. At 2000 meters, the concentration of tarry substances was 100-200 mg/cu m. In neighboring residences, sulfur dioxide concentrations were almost identical with those outdoors, while fluoride concentrations were even greater. Forty-one percent of the patients from the village where the plant was located had active tuberculosis or were carriers of tubercule bacilli. It is proposed that the pollutant discharge be reduced by the use of tall stacks, fluoride trapping devices, and more suitable electrodes.

17986

Yunghans, Roland S. and Thomas B. McMullen

AMBIENT AIR FLUORIDE CONCENTRATIONS IN THE UNITED STATES. Preprint, Public Health Service, Cincinnati, Ohio, National Air Pollution Control Administration, 18p., Aug. 1969. 8 refs.

The total water soluble fluoride concentration was determined in samples of suspended particulate matter collected through an air surveillance network in 1966 and 1967. A fluoride-selective electrode method was used which is suitable for anlayzing a large number of samples. Results of analyzing over 5400 samples from urban stations, and over 1400 samples from nonurban stations are summarized. Eighty-seven percent of all measurements at urban stations showed concentrations below 0.05 micrograms/cu m, the threshold of detectability. Thirteen measurements (0.2% of urban samples) exceeded 1.00 micrograms/cu m; the maximum was 1.89 micrograms/ cu m. Ninety-seven percent of all measurements at nonurban stations showed no detectable amounts of fluoride. Three nonurban samples (0.2%) contained fluoride concentrations exceeding 0.10 micrograms/cu m; the maximum was 0.16 micrograms/cu m. The maximum fluoride levels found were well below most of the published standards for a 24-hour average concentration of soluble fluoride, as HF (10 micrograms/cu m in the U. S. S. R. and Czechoslovakia; 7 micrograms/-cu m in Montana; 5 micrograms/ cu m, in Pennsylvania; and 3.3, 1.61 and 0.8 micrograms/cu m in industrial, urban, and rural areas of New York State). No geographic patterns were evident, nor did the data cover a long enough period to reveal trends. Generally it can be said that airborne water soluble fluoride concentrations are not approaching the currently acknowledged thresholds that would cause concern for human well-being. (Author abstract modified)

18537

Giovanardi, Augusto and E. Grosso

INVESTIGATION OF AIR POLLUTION IN THE CITY OF MILAN. PART VI. PRESENCE AND BEHAVIOR IN THE CITY. (Indagini sull inquinamento atmosferico della citta di Milano. Nota VI. Presenza e comportamento nell atmosfera urbana). Text in Italian. Nuovi Ann. Igiene Microbiol. (Rome), vol. 9:31-36, Jan./Feb. 1958. 13 refs.

Some results of an air quality measurement program, begun in 1956 in Milan to determine such pollutants as carbon monoxide, carbon dioxide, hydrogen sulfude, chlorine, fluorine, ammonia, nitrogen oxides, and particulates, are reported. Carbon monoxide levels in the areas of heaviest traffic did not exceed 62 ppm. Hydrogen sulfide, chlorine, and fluorine do not occur in the central zones of the city, although fluorine is present in the neighborhood of an enamel-varnish factory. High concentrations of CO2 occurred in both residential and industrial areas. Concentrations of ammonia and nitrogen oxides did not exceed 0.72 and 0.05 ppm, respectively.

19145

TNO, Delft (The Netherlands), Research Inst. for Public Health Engineering

ATMOSPHERIC POLLUTION. ANNUAL REPORT. p. 15-23, 1968.

Air quality measurements conducted in The Netherland in 1968 focused on the area between Rotterdam and the North Sea, the area between the Hook of Holland and The Hague, The Hague, Delft, Zuid Holland, north-eastern Gronigen, the North Sea Canal, and the Sloe area. Most of these areas are highly urbanized and characterized by concentrations of several industries. In addition to simple measurements made with deposit gauges and Liege spheres, measurements were made to determine concentrations of sulfur dioxide, hydrogen fluoride, standard smoke, and carcinogenic substances. For SO2 and smoke measurements, many stations employed a new fourfold, automatic absorption apparatus. Other new gas detection apparatus, and new analytical methods, are reviewed. In general, the measured concentrations were not alarming, but in many cases it is thought desirable to continue measurements.

19966

Koehler, Albert and Walter Fleck

CONCENTRATION OF GASEOUS AIR POLLUTANTS IN POLLUTED AND 'CLEAN' ZONES. Staub (English translation from German of: Staub, Reinhaltung Luft), 29(12):21-26, Dec. 1969. 4 refs.

The concentration of gaseous air pollutants in polluted and clean zones was measured in 1967 and 1968. Carbon dioxide was measured by an infrared analyzer, total sulfur concentration by the water wash-bottle method, nitrogen dioxide by the Saltzman method, and fluorine by the standard impinger and colorimetric methods. In addition, the concentrations of suspended matter, dust precipitation, radioactivity, and biological objects were also determined. An analysis of the annual and daily variations shows distinct differences between the polluted and clean zones. The concentrations of sulfur compounds and nitrogen dioxide are 10 to 15 times higher in the polluted zones than in the clean zones. The CO2 concentration, which is largely controlled by natural phenomena, is up to 20 ppm higher in polluted zones than in clean zones. (Author summary modified)

21419

Perin, G., V. Gasparini, and C. Piccoli

AIR POLLUTION IN THE CITY OF BOLZANO. PART II: RESULTS AND REFLECTIONS ON FOUR YEARS OF STUDIES. (L inquinamento atmosferico della citta di Bolzano. Nota II: Risultati e considerazioni di un quadriennio di Ricerche). Text in Italian. Ann. Sanita Pubblica (Rome), 30(5):795-831, 1969. 110 refs.

Air pollution studies in the city of Bolzano were begun in 1963 and interrupted at the end of 1964, at which time a city ordinance required the installation of smoke purifiers in home heating plants. Studies were resumed in September 1965 and terminated in the spring of 1967. At 6 sampling stations, the pH of rainwater was determined, as well as the resence of dust, calcium, magnesium, chloride, fluoride, sulfate ions, sulfur dioxide, chlorine gas, iron, fluorine gas, and aluminum; dust was additionally analyzed according to size of particulates. Meteorological conditions were also observed. Comparing the two periods of study, insoluble tarry substances notably decreased after the installation of smoke purifiers, while the content of insoluble inorganic pollutants increased, particularly at two stations. Chloride ion content was higher in the summer. Taking account of seasonal variations, the sulfur dioxide content was clearly reduced during the second period of study. In comparison with other cities, the residential areas of Bolzano showed better air quality than such areas in Melbourne, Naples, Modena, and London, while the industrial zone was about comparable to that of such large industrial complexes as Nagoya, Muenster, Mestre-Marghera, and Pittsburgh. Neither the industrial nor the residential zones gave values that exceeded the acceptable limits.

22348

Lahmann, Erdwin and Karl-Ernst Prescher

AIR POLLUTION TEST PROGRAM IN BERLIN. (Luftuntersuchungsprogramm in Berlin. Text in German. Schriftenreihe Ver. Wasser Boden Lufthyg. (Berlin), no. 33:19-24, 1970. 19 refs.

On August 1, 1968, six automatic testing devices for sulfur dioxide were installed in 6 different locations of West Berlin and the readings were transmitted by telephone to a central recording station. Subsequently the testing program was enlarged by the continuous testing of carbon monoxide, carbon dioxide, dust, and hydrocarbon levels in one location, by intermittent SO2 level tests in 82 other localities, by intermittent testing of fluorine, chlorine, and ammonia levels in one station, and of dust in 2 stations and 2 other localities. Wind velocity and wind direction were measured in 1 station in addition to the meteorological data available from the Meteorological Institute of the Free University of West Berlin. The SO2 emission recorded equalled or exceeded the SO2 concentration measured in similar programs in other West German cities which is explained by the widespread use of sulfur-rich brown coal from deposits in central Germany by Berliners. Under adverse weather conditions, CO levels in sections with little traffic were as high as in streets with heavy traffic. The highest median half-hour levels exceeded 20 ppm CO. In remote sections of the city, emission fluctuations are influenced by meteorological factors much stronger than in heavy traffic areas. During the period from August to January, CO emission exceeded by from 50-97.5% that measured during the period February-July.

22359

Lahmann, Erdwin and Juergen Westphal

THE CORRELATION BETWEEN SULFUR DIOXIDE AND FLUORIDE EMISSION. (Untersuchungem ueber die Korrelation zwischen Schwefeldioxid- und fluorid-Immissionen). Text in German. Schriftenreihe Ver. Wasser Boden Lufthyg. (Berlin), no. 33:25-28, 1970. 11 refs.

The existence of a correlation between the emission of sulfur dioxide and of fluorides was studied from analytical data collected over 12 month periods in Berlin, in Mannheim-Ludwigshafen, and around Cologne. Fluorides were determined by the impinger method; SO2, by an automatic testing device or manually by the silica gel method. The median correlation coefficients calculated for Berlin for periods of 1 month exceeded the value plus or minus 0.27 only once (February 1969, r equalled 0.71). This low correlation also emerged from calculations for the other two areas under study. The exceptionally single high coefficient must be considered accidental In none of the three areas did the results of correlation analysis indicate the existence of a linear relationship between SO2 and fluoride emissions. No conclusions can be drawn from SO2 measurement on simultaneous fluoride emission as in the case of CO measurements where a correlation was found to exist with hydrocarbon and lead emissions.

23392

Paccagnella, B. and M. Dechigi

AIR POLLUTION AND RESIDENTIAL AREAS--RELATIONSHIP BETWEEN AIR POLLUTION AND TOWN PLANNING. World Health Organization, Copenhagen (Denmark), Regional Office for Europe, Proc. Conf. Public Health Aspects Air Pollution Europe, Milan, Italy, 1957, p. 218-235. 6 refs. (Nov. 6-14.)

In the early stages of research on the degree of pollution and its distribution in Padua and Venice, a method of measurement based on instantaneous sample collections was adopted. Samples were taken in such a way that deposit meters and peroxide cylinders were always placed downwind. Thus, it was possible to gather data indicating the maximum concentration of polluting substances in the wind stream, irrespective of difficulties caused by variations in or turbulence of atmospheric currents. A total of 803 analyses for sulfur dioxide, nitrogen dioxide, and elemental fluorine have been performed to date for Padua. The results are presented in tabular form and the distribution of the pollutants shown on a map. The implication of the results for town planning is noted.

23760

Adams, Donald F., Delbert J. Mayhew, Richard M. Gnagy, Eugene P. Richey, Robert K. Koope, and Ivan W. Allen

ATMOSPHERIC POLLUTION IN THE PONDEROSA PINE BLIGHT AREA. Ind. Eng. Chem., 44(6):1356-1365, May-Aug. 1952. 13 refs. (Presented at the American Chemical Society Meeting, 119th, Cleveland, Ohio.)

The ponderosa pine trees in the industrialized area north of Spokane, Wash., have exhibited a characteristic reddening of the needles since 1943, known locally as 'ponderosa pine blight.' The blighted area now embraces approximately 50 square miles, and the trees within a 3-square mile area near the center are dead. As a portion of a comprehensive investigation, the concentrations of gaseous fluorine and sulfur compounds in the air during the growing season of 1950 have been determined through operation of twelve air-sampling stations and a mobile air-analysis laboratory. Analysis of rainwater samples obtained during each rainy period throughout October and November 1950 at 82 locations established the

points of origin of the contaminants and the extent of their dispersion. Meteorological and topographical conditions in the ponderosa pine blight area, which control the dispersion of pollutants and explain the damage and pollutant concentration patterns, are discussed. Concentrations of gaseous fluorine compounds in the atmosphere of the area will serve as a guide in controlled fumigation of ponderosa pine. (Author abstract)

23845

Cholark, J., L. J. Schafer, and R. F. Hoffer

RESULTS OF A FIVE-YEAR INVESTIGATION OF AIR POLLUTION IN CINCINNATI. Arch. Ind. Hyg. Occupational Med., Vol. 6:314-325, 1952. 3 refs. (Presented at the American Industrial Hygiene Association, Air Pollution Division, Annual Meeting, 13th, Cincinnati, Ohio, April 24, 1952.)

The results of an air quality investigation in Cincinnati, Ohio are presented. Samples were taken at 18 sites, several times monthly for a period of five years. At each of the stations, samples of suspended matter were collected by an electrostatic precipitator and were analyzed several ways to determine the composition of the particulate matter suspended in the atmosphere. Compounds identified included various metals, sulfur dioxide, fluorides, chlorides, carbon monoxide, carbon dioxide, aldehydes, nitrates, and ammonia. In addition, measurements of odors and dust fall are reported. Relationships between pollutant concentration and traffic density, season, and meteorological conditions are discussed. Plans for the continuation of the monitoring network are described.

23862

Valach, Roman

FLUORIDES AND CHLORIDES IN PRECIPITATION SAMPLES IN BOHEMIA. (Fluoride und Chloride in Niederschlaegen von Boehmen). Text in German. Stud. Geophys. Geod., vol. 11:241-251, 1967. 33 refs.

Analysis of results of fluoride and chloride content determinations in precipitation samples in Bohemia disclosed that, in samples containing ash, the halogens came mostly from the ash while in samples that contained little or no ash the halogens came from the atmosphere. The atmospheric levels of F and Cl were unaffected by the intensity of coal combustion and it is doubtful that industrial emission is the principal source of Cl and of F in precipitation. These findings seem to confirm the hypothesis that both Cl and F in the atmosphere are mainly of volcanic origin and originate from exhalations of highly hygroscopic chlorides and fluorides. Hydrofluoric acid forms heavy fogs with humidity which can be observed in the north Bohemian coal basin where the coal is rich in F. The Cl/F ratio in precipitation was found to be approximately 10, the same ratio in volcanic gases in approx. 6.

24717

MacIntire, W. H., L. J. Hardin, and Winnifred Hester

MEASUREMENT OF ATMOSPHERIC FLUORINE. ANALYSES OF RAIN WATERS AND SPANISH MOSS EXPOSURES. Ind. Eng. Chem., 44(6):1365-1370, June 1952. 6 refs. (Presented at the American Chemical Society, Wilson Dam Section and the Southern Association of Science and Industry, Inc., Southwide Meeting, Wilson Dam, Ala., Oct. 18-20, 1951.)

Rainfall collections at six points were analyzed to measure the periodic washdowns of fluorine from the atmosphere in relation to the locations of operations that emit fluoric effluents, and charges of Spanish moss were exposed to measure progressive intake of fluorine from the atmosphere. Longer intervals between rainfall caused higher concentrations of fluorine at the several locations. Proximities of samplings to sources of emissions were reflected by higher concentrations of fluorine in rain waters. Exposures of Spanish moss acquired substantial progressive enhancements in fluorine uptake at points near those where fluoric emissions occurred. The findings demonstrate that these two feasible and economical procedures can be implemented in parallel to establish whether a particular locale is subject to atmospheric pollution and the degree of pollution. Through integration with meteorological records, the determined occurrences of fluorine in the rain waters might indicate the origins of the contaminative effluents. (Author abstract)

24736

Thompson, Richard J., Thomas B. McMullen, and George B. Morgan

FLUORIDE CONCENTRATIONS IN THE AMBIENT AIR. Preprint, Air Pollution Control Association, New York City, 14p., 1970. 15 refs. (Presented at the Air Pollution Control Association, Annual Meeting 63rd, St. Louis, Mo., June 14-18, 1970.)

Data are reported for ambient atmospheric concentrations of water- soluble fluorides determined in samples of suspended particulate matter collected from rural and urban sites on glass-fiber filters by the National Air Surveillance Network. Data for over 12,000 samples collected in 1966, 1967, and 1968 are examined to give an estimation of current air quality with respect to fluoride content. Samples were extracted with pure boiling water and the fluoride concentration of the extracts measured using a fluoride-ion selective electrode. The data were tabulated on an annual basis; a table is presented summarizing the results, which show that the fluoride content in the majority of the samples is below the minimum detectable amount of 0.05 micrograms F/cu m. It is concluded that only in rare instances would the fluoride concentrations at the sites sampled be in excess of published standards, and that airborne fluoride does not prevail in the general environment at concentrations anywhere approaching the currently acknowledged thresholds endangering human safety. It is also noted, however, that the urban sites in this network represent center-city business environments, and that the findings do not refute results of special investigations near major sources of fluorides that clearly document excessive levels and adverse effects on vegetation and livestock. (Author abstract modified)

24801

McHenry, Charles R. and Hoyt Charles

MONITORING OF FLUORIDE CONTENT OF AIR, WATER, AND VEGETATION. Air Pollution Control Assoc. J., 11(2):66-70, Feb. 1961. (Presented at the Air Pollution Control Assoc. Annu. Meet., 53rd, Cincinnati, Ohio, May 22-26, 1960.)

The phosphate fertilizer industry is one of several industries that emits gaseous fluorides from certain manufacturing processes. Ther are nine major companies located in the Polk County, Fla. area engaged in the manufacture of various phosphate fertilizers. American Cyanamid Co. was one of the last companies in the area to build a triple superphosphate manufacturing plant. These types of plants emit gaseous fluorides in the forms of silicon fluoride and hydrogen fluoride as a by-product. In order to reduce emission of gaseous fluoride to a minimum, certain control measures were incorporated in the blueprint specifications of the new processing plant. A five-year air pollution study was started in 1956 to measure the effectiveness of the built-in control devices. The study, still in progress, includes: continuous monitoring air and

water sampling studies, vegetation surveys, and a meteorological monitoring program. Results of the study have been used to determine a fluoride emission rate for the plant that will be consistent with the air pollution laws of the state of Florida and the maintenance of desirable conditions around the plant site. Additional control equipment is presently being installed to accomplish this objective. To date, American Cyanamid Co. has spen 1.4 million dollars in the study to set plant operating standards and for pollution control equipment. The air pollution monitoring program has been an indispensable tool in defining the extent of the problem at Brewster and in determining necessary control measures for maximum production without air pollution. (Author summary modified)

25093

Quellmalz, Eberhard

RESULTS OF FLUORINE MEASUREMENTS. (Ergebnisse von Fluormessungen). Text in German. Staub, Reinhaltung Luft, 30(7):292-294, July 1970.

Fluorine emissions involving three glass works, one fluorine minerals processing plant, one clay works, one electric metal smelting plant, and one brick factory were measured. The emission of one glass factory was 15 to 60 mg F/cu m, the emission at a distance of 80 m from the source 100 microgram F/cu m. Pine needles at a distance of 400 m turned brown as a result. The emission levels of the plant processing fluorides fluctuated between 2.6 and 7.8 microgram F/cu m at a downwind distance of 100 to 300 m. A brick factory processing fluorine-rich clay which was put into operation recently in a wooded area severely damaged trees in the surrounding woods. The emission was between 50 and 70 mg F/cu m, the median emission level 50 m downwind was 4.5 microgram F/cu m. The emission measurements undertaken at other factories yielded comparable results. The median fluorine emission level measured at the periphery of the city of Karlsruhe where no fluorine generating industry was located within a radius of several miles was around 0.6 microgram F/cu m which was obviously due to the effect of the city.

25593

Gilbert T.

PROTECTION OF ENVIRONMENT. (Nachbarschutz). Text in German. Rheinisch-Westfaelischer Technischer Ueberwachungsverein e. V. Jahresbericht, 1969:57-66. 16 refs.

Methods and results of several hundred ambient concentration and emission determinations of sulfur dioxide, fluorine, chlorine, ammonia, carbon monoxide, hydrogen sulfide, nitrogen oxides and of hydrocarbons emitted by a variety of industrial enterprises and shops undertaken in 1969 in the State of Nordrhein-Westfalen are tabulated and analyzed as are 469 expert opinions concerning pollution rendered as part of a certification procedure of new enterprises from all industrial fields. Procedural and instrumental changes designed to improve on present practices as they result from the analysis are proposed. These involve emission measurement of boiler plants, dust emission by large boiler furnaces, the operation of refuse incinerators, the supervision of steam and hot water boiler plants, exhaust gases from combustion engines and errors in pollution measuring instruments (Diesel-engin smoke). Noise pollution measurements issuing from 65 different sources undertaken during 1969 are tabulated and recommendations designed to reduce the noise level are submitted. Decrees, norms and guidelines concerning pollution promulgated during 1969 in the state of Nordrhein-Westfalen are listed.

26026

Niigata Prefectural Government

REPORT ON AIR POLLUTION STUDY, NAOETSU REGION. Naoetsu chiiki no taiki osen chosa hokokusho. Text in Japanese. 104p., March 1970.

From August 1967 through October 1969, a study on air pollution was undertaken in the Naoetsu region, Niigata Prefecture. Sulfur oxides were measured by the PbO2 and the electroconductivity methods. At the same time, the pararosaniline method was partly applied in order to measure merely sulfur dioxide. Suspended particulate matters and dust fall were respectively measured by the British standard suspended particle matter meter and the high volume air sampler. The alkali filter paper method and lime filter paper method (LTP method) were applied in the measurement of fluorides. Sulfur oxides recorded 0.26 mg SO3/100 sq cm PbO2 in 1967; in general, it is increasing yearly. In reference to the seasons, in some places the level increased in spring and summer and decreased in autumn and winter; the contrary occurred in other places. In two or three places around the industrial area, a comparatively high level of concentration was detected, but the pollution was slight. Suspended particulate matter recorded 11.4 t/sq km/month in 1967 and is gradually increasing; however, the level was about that of a medium industria city. The level of drifting dust was generally high; attention must be given to the sectional pollution. As to fluoride sectional pollution was recognized. The problem of the content of sulfur and fluorine in the test plants still needs further study; however, the result of the analysis of fluorine content briefly coincides with the other results on air pollution studies. This report includes preparatory study on the effect of air pollution upon plants in Naoetsu region. As a result, suppression of growth and abnormal leaves in the plants in Hinode town and Fukuhashi in Naoetsu city were recognized as notable.

26086

Helms, Grady T., James H. Southerland, Kenneth R. Woodward, Ibrahim J. Hindawa, Dale H. Coventry, and Charles D. Robson

CHATTANOOGA, TENNESSEE -- ROSSVILLE, GEORGIA INTERSTATE AIR QUALITY STUDY 1967-1968. National Air Pollution Control Administration, Durham, N. C., Div. of Abatement, NAPCA Pub.-APTD-0583, 120p., Oct. 1970. 25 refs. NTIS: PB 195145

Results are presented for an air quality survey conducted in the Chattanooga, Tennessee - Rossville, Georgia interstate area from October 1967 through April 1969. The survey included air quality measurements, meteorological measurements, vegetation effects measurements, material effects studies, and an emissions inventory. The climatology of the area was found to be characterized by light average wind speeds, topographically confined flow, and frequent inversion conditions -- factors associated with poor pollutant dispersion. A suspended particulate problem exists in the area, with maximum concentrations in the downtown Chattanooga-Rossville valley and the Volunteer Army Ammunitions Plant (VAAP), where nitrogen oxide concentrations are also extremely high. Sulfur dioxide concentrations are lower than national standards; oxidant, hydrocarbon, and carbon monoxide levels are comparable to national levels. At study sites where selected vegetation was exposed, damage attributable to nitrogen dioxide, ozone, peroxyacetyl nitrate, sulfur dioxide, hydrogen fluoride, and an interaction of low concentrations of these and other pollutants developed. Vegetation at the VAAP revealed damage characteristic of overexposure to nitrogen dioxide, sulfur dioxide, and acid mist. Steel and zinc corrosion rates at one VAAP site are excessive, as are dye-fading rates in the

area of the plant. Silver tarnishing, the index of sulfide gas pollution; occurs at all locations in the area, but values do not exceed the National Interstate Surveillance Project upper quartile. Quantities of pollutants emitted in Hamilton County, Tennessee and Walker and Catoosa Counties, Georgia in 1968 are summarized, as is the percent contribution of all pollutants by source category. Industrial process losses are probably the most important source, followed by mobile sources and stationary fuel combustion.

26702

Bay Area Air Pollution Control District, San Francisco, Calif.

AIR POLLUTION AND THE SAN FRANCISCO BAY AREA. 29p., Nov. 1970.

Air pollution emissions in the Bay Area are presented for 1969 by source category. The Bay Area Air Pollution Control District is comprised of six counties, Alameda, Contra Costa, Marin, San Francisco, San Mateo, and Santa Clara. It is governed by a twelve man Board of Directors, with each county represented by two members, which has the power to develop and enforce regulations for the control of air pollution in the District. To advise the Board and the staff, there is a 20-man Advisory Council, appointed by the Board. Members of the Advisory Council represent special interest groups and must include representatives of colleges or universities, health agencies, agriculture, industry, community planning, transportation, professional engineers, contractors, architects and organized labor. An important feature of the District is its Hearing Board, which makes findings of fact and can issue orders of abatement. The Bay Area Air Pollution Control District operates on a performance standard basis rather than on a permit system. Regulations have been adopted to control open burning, emissions of particulates and dense plumes, hydrocarbons and sulfur dioxide emissions, as well as reactive organic compounds. A Combined Pollutant Index was established in 1968 and includes oxidants, carbon monoxide, nitrogen dioxide, and particulates. The enforcement division comprises thirty-eight inspectors, as well as an engineering section and source testing groups. The technical division embraces the laboratory, air monitoring, data anlysis and meteorology, and library sections. Examples of particulate matter are indicated, and visibility reduction is mentioned. Important gaseous emissions include carbon monoxide, sulfur oxides, hydrogen sulfide, fluoride, oxides of nitrogen, and organic compounds. Photochemical smog is mentioned, as well as meteorological factors and topography. Health effects, plant damage, and material deterioration are also reviewed. Government agencies and air quality standards are discussed.

27254

Kumamoto Prefectural Government (Japan), Public Nuisance Section

REPORT OF INVESTIGATION OF THE AIR AND NOISES. (V): JANUARY, 1969 - MARCH, 1970. (Taiki, soon chosa hokoku sho. Dai V ho. (Showa 44 nen 1 gatsu - Showa 45 nen 3 gatsu)). Text in Japanese. 212p., May 1970.

Investigations of air pollution, meteorology, and environmental pollution were carried out at Kumamoto, Arao, Udo, Yatsushiro, Tuura-cho, and Minamata of Kumamoto Prefecture from January 1969 to March 1970; the results are reported. The average annual amounts of dust fall are within a 5.15 - 12.34 t/sq km/month level (by the deposit gauge method) and it is decreasing in all cities with every year. Among the contents of dust fall nitrate (-) was frequent in the cities where they use coal for fuel and sulfate (-2), chlorine (-), and calcium (+2) in the cities where there were carbide or chemical factories. Concentrations of sulfur dioxide (by the PbO2 method) are increasing in all cities; the highest value of the average annual concentrations was 0.94 mg/100 sq cm/day at Arao and the lowest was 0.23 mg/100 sq cm/day at Taura There was about 33% increase in general compared with those of the previous year. The results of automatic measurements of SO2 and floating dust at Arao and Yatsushiro revealed that the average annual values were 2.60 ppm at Arao and 0.86 ppm at Yatsushiro; the average annual index of the degree of pollution by floating dus was 12.5% and 4.29%, respectively. Measurement of concentration of fluorine in falling dust and in indicator plants has been carried out since June 1969 in order to perform examinations before the establishment of a factory for electrolysis of aluminum at Arao. Carbon monoxide, nitric oxide, nitrogen dioxide, and the amount of floating dust and its contents were measured in order to investigate the effects of automobile traffic volume and automobile exhaust gases.

28097

Schedling, J. A.

THE MEASURING AND ANALYSIS OF ATMOSPHERIC POLLUTION. (Ueber Messungen und Analysen von Luftverunreinigungen). Text in German. Arch. Hyg., 154(4):349-357, 1970. 5 refs.

The tendency prevails not to limit the measuring of atmospheric pollution to the determination of a single pollutant like to sulfur dioxide because the assumption that the level of an indicato substance is a characteristic measure of the sum of all pollutants is valid only to a limited extent, if at all. Five hundred dust fall measurements performed over a period of two years (1962-1963) in a center city site in Vienna and 2000 dust fall measurements performed in 1965 and 1966 and continued at the same site in 1969 by means of a dust collection filter device at 1 and 9 m above ground were evaluated and the levels of lead, of benzopyrene and of fluorine compounds were determined. Lead compounds were determined polarographically; benzopyrene, spectrometrically; and fluorine compounds, by means of an ion-sensitive electrode. The present air pollution monitoring program in the city of Vienna will have to be extended to include nitrogen oxides and hydrocarbons and later also asbestos dust and oxidants. The pollution levels will have to be evaluated on the basis of internationally agreed air quality criteria not only for their immediate toxicity but for their hygienic implications in the overall pollution picture as seen by the WHO.

28188

Huffstutler, K. K.

FLUORIDE CONCENTRATIONS IN VARIOUS RECEPTORS NEAR PHOSPHATE INDUSTRIES. Preprint, Air Pollution Control Assoc., Pittsburgh, Pa., 17p., 1970. (Presented at the Air Pollution Control Association, Annual Meeting, 63rd, St. Louis, Mo., June 14-18, 1970, Paper 70-153.)

Within Polk, Hillsborough, and Manatee Counties in west central Florida are located 17 phosphate fertilizer and related phosphate product manufacturing plants, 13 of them enclosed within seven and a half mile radius in Polk County. In 1965 an emission limit regulation was adopted limiting each company to 0.6 lb fluoride per ton of P2O5 manufactured in any one 24-hr period prior to May 1, 1964, allowing one year for compliance. Total industry emissions dropped from 11,700 lb per day in 1965 to 2700 lb in 1969. Samplin data show a related decrease in ground level concentrations. On the basis of data collected in a pasture grass sampling program started in 1963, a 40 or 45 ppm 'iso-fluor' was drawn representing the average annual at each station, in order to measure affected areas and

to define land ownership and use patterns. Measurements of fluoride accumulation in citrus leaves did not demonstrate correlation with ambient air fluoride levels; however, in a preliminary test of root uptake of fluoride, a citrus tree receiving gyp pond water showed an increase in fluoride content double that of a control tree.

28771

Nakagawa, Yasusuke, Isao Ogawa, Masayoshi Mizukami, Akira Matsuura, and S. Kaji

SAMPLING AND ANALYZING OF FLUORIDES. PART I. (Hasseigen kojo ni okeru fukkabutsu no sanpuringuho oyobi bunsekiho ni tsuite. Dai-1-po). Text in Japanese. Taiki Osen Kenkyu (J. Japan Soc. Air Pollution), 5(1):89, 1970. (Proceedings of the Japan Society of Air Pollution, Annual Meeting, 11th, 1970.)

On the assumption that the present JIS method of measuring fluorides as gases alone is inadequate for determining total fluorides emitted to the atmosphere in industrial areas, the following experiment was conducted. Fluoride gases as well as particulates were collected inside and outside plants by dust tubes with copper wool and polyethylene impingers. The items sampled were gases and mists under 20 micron and those particulates over 20 micron. The hydrogen fluoride values measured are tabulated. They indicate that a substantial amount of HF is also contained in particulates. Total fluoride was 2.30 to 6.53 HF ppm in one factory and 24.80 to 30.60 HF ppm in a second factory, B. In the area of the second factory, values were 325 to 351 ppb.

29040

Roenicke, G.

DESCRIPTION OF THE 'SCHAUINSLAND' STATION, GERMANY, AS AN EXAMPLE OF A PILOT STATION. In: Research Facilities, Necessary to Adequately Support Measuremnt of Low Levels of Pollutants and Follow Their Trends. Organization for Economic Co-operation and Development, Paris (France), Chapt. 2, p. 9-28, Sept. 22, 1970.

Plans are being made to create a world network of background and pollution measurement stations in which a regional or national network is associated with a central laboratory, called a pilot station. The Schauinsland pilot station is one of a network of seven supporting stations in West Germany. Its tasks are to coordinate the measurement methods, measuring equipment, and workin programs of the network; to calibrate measurement methods, to examine limitations of the methods in use, and to develop and test new measurement methods. To obtain samples in unpolluted air, the measurement and testing station is located in open countryside. Methods and instruments used for measuring dust fallout and concentrations of suspended matter, sulfur oxides, nitrogen dioxide, nitrous oxide, and fluorine compounds in the atmosphere are described. Other tasks undertaken include examination of condensation nuclei and recording of atmospheric electrical components. Biological materials, such as pollens and spores, are sampled continuously in a Burkard trap. Meteorological parameters are measured and recorded. Development work in progress includes an investigation of the use o a fluorine-specific electrode under low concentration conditions, automatic recording methods for measuring sulfur oxides and NO2 concentrations, and testing of a calibration procedure which uses a gas mixing pump. The personnel of the station consists of a scientific director and five technicians. Equipment for research and development cost approximately $10,563, routine work equipment cost $51,098, and basic equipment for the laboratory, workshop, office and recreation rooms, office equipment, and miscellaneous items totalled $30,750. Operating costs for one year are estimated at $140,228.

30058

Davis, K. A.

ENVIRONMENTAL MONITORING SUMMARY FOR THE PADUCAH PLANT FOR 1970. Union Carbide Corp., Paducah, Ky., Paducah Gaseous Diffusion Plant, AEC Contract W-7405-eng-26, Rept. KY-629, 9p., April 1, 2971. NTIS: KY-629

Several factors are routinely checked at the Paducah Gaseous Diffusion Plant including uranium fluorides, nitrates, hexavalent chromium, pH, alpha and beta activity, and background gamma radiation. Air and water samples are taken continuously in the vicinity of the plant; samples of the Ohio river are collected monthly; and vegetation samples are taken bimonthly. Air samples are collected through a membrane filter for particulate matter and through a scrubber for fluorides. Vegetation is dried and then pulverized for fluoride analysis. In 1970, alpha activity averaged 0.04 pCi/cu m; beta activity averaged 0.04% of the Radioactivity Concentration Guide; gaseous fluoride averaged 0.45 ppb, 42% less than 1969; fluorides in grass were of a 25 ppm concentration on site and below that off-site (a safe concentration for grazing animals). The water mixed with alkaline wastes became neutralized so that no significant difference in the concentrations of fluorides, chromates, uranium, pH, or radioactivity was found below the mouth of the drainage creeks from that upstream from the Paducah plant. Ground water was also sampled.

30705

MEETING OF THE COORDINATING COMMITTEE ON AIR POLLUTION IN SOUTH HOLLAND (NETHERLANDS). (Coordinatiecommissie meting luchtverontreiniging in Zuid-Holland). Text in Dutch. 19p., 1968.

The coordinating committee on air pollution in South Holland (the province of the Netherlands which includes Rotterdam and The Hague) was activated March 15, 1967 by the Queen s Commissioner. It has no formal membership list and is not incorporated. Its primary purpose is the measurement of air pollution. As of September 1968, an inventory of air pollution measuring stations in South Holland chose 57 stations for the measurement of sulfur dioxide, 44 for the collection of precipitation, five for smoke sampling, three for nitrogen dioxide, and two for hydrogen fluoride. The values obtained from SO2 measurements during the summer of 1966 are plotted on a map of South Holland in the form of iso-risk lines, while dust fall data are plotted in the form of iso-dust fall lines, expressed in tons/sq km of land area. The South Holland data is also compared with measurements in four areas of Great Britain, and in terms of permissible limits established in various other countries, including Russia, Germany, Poland, Sweden, and the USA.

31371

Japan Environmental Sanitation Center, Tokyo

REPORT OF A SURVEY ON ENVIRONMENTAL QUALITY IN THE DISTRICTS UNDER POLLUTION CONTROL PROGRAM. (Kogai boshi keikaku sakutei chiiki kankyo chosa hokokusho). Text in Japanese. 136p., March 1969.

Air pollution, water pollution, offensive odors, and noise in the Chiba/Ichihara, Yokkaichi, and Mizushima districts were surveyed in 1968. Average daily sulfur dioxide concentrations were 0.02 ppm in the Chiba/Ichihara district and 0.01-0.05 ppm

in the Yokkaichi district. Values measured at 28 points in the latter district varied according to direction, wind velocity, and geographical conditions. The mean value of suspended dusts in the Chiba/Ichihara district was 151.6 microgram/cu m, but values as high as 256-1649 microgram/cu m were measured in Yokkaichi. Here iron contents of 105.8 microgram/cu m and 334.0 microgram/cu m were found. Organic sulfur compounds such as dimethyl sulfide (1.0 ppb) and isoprophyl mercaptan (3.5 ppb) were also detected in Yokkaichi City. Nitrogen oxides and hydrogen chloride values in th Chiba/Ichihara district were 0.003-0.025 ppm and 0.01-0.06 ppm, respectively. Fluorine compounds were not detected. Maximum chlorine, formaldehyde, and hydrogen sulfide concentrations of 0.07, 0.057, and 0.005 ppm, respectively, were measured in the summer. In the Mizushima district, two methods were applied to determine offensive odors from petroleum complexes: odorimetry and gas chromatography. With the latter measuring 0.006-0.012 ppm of ethyl acetate. The gas was irritative with a sour and sweet odor. Biological oxygen demand measurements and analysis of bottom soil in Yokkaichi harbor, and 0.20-1.28 milligram/dry kg of mercury in bottom soil of the drainage at a chemical factory in the Mizushima district. Noise levels in residential areas were below or only a little higher than the standard, but noise levels along heavily travelled roads were significantly high.

31396

Grosser, J., K. Horn, and A. Knauer

SOME RESULTS OF AIR HYGIENE RESEARCH IN THE GERMAN DEMOCRATIC REPUBLIC AND THEIR PRATICAL APPLICATION. (Ueber einige Ergebnisse der Lufthygienischen Forschung in der DDR und ihre Anwendung in der Praix). Text in German. Z. Ges. Hyg. Ihre Grenzgebiete (Berlin), 17(6):396-399, June 1971. 23 refs.

East Germany is gradually establishing an emissions-monitoring system. Emission measurements were taken in Berlin, Halle, Magdeburg, Schwerin, and in the Erz Mountains. Sulfur dioxide and dust were identified as the major air pollutants; hydrogen chloride, hydrogen sulfide, chlorine, HCOH, fluorine, arsenic, lead, carbon monoxide, and polycyclic and other hydrocarbons were present to a lesser extent. Several measurements showed high nitrogen dioxide levels in some but not all areas of the country. In the center of East Berlin, monthly average values were 0.007-0.032 NO2 mg/cu m. Comparative measurements with continuous monitors indicated a close relationship between SO2 and dust concentrations. A 90% value of the sum frequency of 0.28 mg/cu m and 0.19 mg/cu m was calculated for dust and SO2, respectively. The high dust and SO2 concentrations found in East Germany are due to the fact that 89.2% of power plants are still fired with soft coal. Based on comparison of death certificates for a rural area and an industrial area, mortality rates due to respiratory disease and heart ailments are higher in the latter area: 4.78/1000 for women and 5.78/1000 for men. For the rural area, the respective rates are only 3.6/1000 and 3.85/1000.

32666

Morik, Joszef, Szilveszter Kelenffy, and M. Saringer Kerteszne

AIR POLLUTION IN THE VICINITY OF THE POWER PLANT ON NOVEMBER 7 AND OF THE ALUMINUM WORKS AT VARPALOTA. (A levego szennyezettsege a November 7. Hoeromu es a Varpalotai aluminiumkoho kornyezeteben). Text in Hungarian. Idojaras (Budapest), no 6:344-351, 1967. 12 refs.

Air quality measurements were made showing that emissions from an aluminum plant at Varpolata and an adjacent power plant are detectable at a distance of 1.5 to 2 km, and are strongest in the southerly direction. In the eastern part of the region, south of the aluminum works, conditions are much worse than in the western part due to the presence of sulfur dioxide, dust, and fluorine, and to prevailing wind conditions. The amount of bituminous matter, 3,4-benzpyrene, and fluorine in the dust found on the vegetation in this region was measured. The fluorine content in the dry matter of the plants was also determined. The amount of 3,4-benzpyrene, caused by the tar vapors emitted from the aluminum works, was significantly higher in the dust adhering to the plants than in that collected in housing districts. Approximately 19.4 mg benzpyrene/sq m of plant surface was found; fluorine content was 6.9 mg/sq m of leaf surface. The average fluorine content of the dry matter of plants was 67.5 mg. The fluorine content is significantly higher than the normal value of 1 mg.

32679

Hendrickson, E. R.

AIR SAMPLING AND QUANTITY MEASUREMENT. In: Air Pollution. Arthur C. Stern (ed.), Vol. 2, 2nd ed., New York, Academic Press, 1968, Chapt. 16, p. 3-52. 64 refs.

Devices and techniques for determining the concentration of pollutants in the atmosphere are important to establish hazardous levels in the environment, to determine the efficacy of ameliorative measures, and to appraise contamination from a process or source. Problems encountered in sampling may include sample size, sampling rate, duration of sampling, collection limitations, analytical limitations, alteration of constituents, storage effects, accuracy and precision requirements, collecting versus recording samplers, units of expression, and computation of the results. Common equipment needs are vacuum sources, metering devices, and supplementary devices such as a timer. Sampling of aerosol contaminants may be done by filtration, impingement, sedimentation, electrostatic precipitation and, centrifugal methods. Techniques for sampling gaseous contaminants discussed are adsorption, absorption, freezeout, and grab sampling. Simplified techniques for sulfur dioxide, gaseous fluoride, hydrogen sulfide, and ozone are presented. Types of recording instrumentation and the principles of measurement are briefly described.

33017

Wilkniss, P. E. and R. E. Larson

USE OF ACTIVATION ANALYSIS TO DETERMINE THE CHEMICAL COMPOSITION AND ORIGIN OF PARTICULATES COLLECTED IN THE MARINE ATMOSPHERE. International Atomic Energy Agency, Vienna (Austria), Nucl. Tech. Environ. Pollut. Proc. Symp., Salzburg (Austria), 1970. p. 159- 168. 26 refs. (Oct. 26-30, Paper IAEA-SM-142a/6.)

Pollution of the marine atmosphere is steadily increasing, as indicated by increased lead concentrations in polar ice samples and ocean surface waters, by the observance of pesticides transported with wind-blown dust over the Atlantic and Indian Oceans, and by a general increase in ambient aerosol concentrations probably of man-made origin. The use of neutron activation, photon activation, and proton activation analysis has been investigated to determine the elements boron, fluorine, sodium, sulfur, chlorine, potassium, calcium, manganese, bromine, strontium, and iodine in particulate samples from the marine atmosphere. Methods were developed for collecting airborne particulates on ships and aircraft and at shore stations. Appropriate sample preparation procedures were developed for the different types of activation analysis. The

implication for pollution studies is that, by determining elemental ratios such as F/Cl, Na/Cl, Na/K, Ca/S, and Mn/Cl, one can determine whether an aerosol is of natural origin or of man-made origin. Samples taken along the Atlantic coast of the U. S. show the influence of polluted continental air masses in near-shore region; influx of African dust was found in the middle of the Atlantic, and pure marine aerosols were analyzed in Hawaii. (Author abstract modified)

33080

Gatz, Donald F. and James E. Carson

SULFUR HEXAFLUORIDE: ATMOSPHERIC BACKGROUND CONCENTRATIONS. PRELIMINARY RESULTS. In: Radiological Physics Division Annual Report. Environmental Studies. Argonne National Lab., Ill., Radiological Physics Div., p. 110-120, 1970. 4 refs. NTIS: ANL-7760, Part III

Over 100 air samples were collected in Chicago urban and suburban areas and at the Argonne National Laboratory and analyzed for atmospheric sulfur hexafluoride backgrounds. Sampling times were about five seconds for samples collected in evacuated one liter cylinders and 24 hours for samples collected in 12 liter plastic bags. Samples were analyzed with a gas chromatograph and a nickel(63) electron capture detector. Sulfur hexafluoride concentrations ranged from less than detectable (two picoliters/liter) to greater than 500 picoliters/liter. The highest values were found in five-second samples collected at Argonne, which has several known sources of SF6. However, a number of the Chicago samples also showed detectable SF6 concentrations. (Author abstract modified)

33108

Fuji City Citizens Committee for Environmental Pollution Control (Japan)

REPORT OF THE SURVEY ON PUBLIC NUISANCE IN FUJI AREA (1). (Fuji chiiki kogai chosasho, dai 1-pen). Text in Japanese. 88p., Sept. 1969.

Pollution in the Fuji industrial area includes detailed data on climatic characteristics, the mechanism and the state of air pollution in the area centered around Motoyoshihara Junior High School, comparison with Yokkaichi city, bad odor and noise, sources of odor emission, a survey of respiratory diseases in the area, results of questionnaires, water pollution of the sea and rivers, influence of pollution on plants and agricultural produce, and the state of pollution in the neighboring Fujikawa township. Fuji Municipal Motoyoshihara Junior High School is located in the most polluted area in the entire Fuji industrial complex; situated on a sand dune near the shore of Suruga Bay, it is flanked by four large plants on the west and 10 on the north. The sulfur dioxide counts go up characteristically with north-northwest winds; with 5 m/sec winds, it can go above 0.1 ppm. The average SO2 count from five months in 1968 was 0.093 ppm. The pollution sources include Kraft pulp mills, cellophane plants, chemical factories, Tagonoura port dredgers, aluminum electrolysis plants, fertilizer plants, and automobile exhaust gas. In the neighboring Kanbara township, there is also a light metal company. Pollutants are soot and other particulates (lime, mirabillite), sulfur dioxide, hydrogen sulfide and other sulfides, hydrogen fluoride, chlorine gas and chlorides, nitrogen compounds, and dusts. According to the investigation in April 1968, the total heavy oil consumption in Fuji city was 2,240 kl/day; black liquor, 2,750 kl/day; coal, 23 t/day; coke, 5 t/day; and wood, 16 t/day. The calculated total sulfur dioxide emissions was 130 t/day from heavy oil and 49 t/day from black liquor. According to an investigation by the Fuji Medical Association between Nov. 1967 and Oct. 1968, bronchitis and asthma cases in the polluted areas were 2.5 times as many as those in nonpolluted areas, and cases of asthmatic bronchitis in the former were four times as many as those in the latter. The ratio of asthmatic children in polluted and nonpolluted areas was 37:18; the number of absences, 131:27; and average absence per child, 3.63:1.49.

33309

Lindberg, Walter

ATMOSPHERIC POLLUTION PROBLEMS IN NORWAY. National Society for Clean Air, London (England), Intern. Clean Air Conf. Proc., London, England, 1959, p. 21-22. 4 refs. (Oct. 20-23.)

In the past, air pollution in Norway was not a serious problem and only caused rare effects on human health, such as manganese pneumonias. Recently, air pollution from the aluminum industry has led to grass pollution with fluorides and resulting fluorosis in cattle. Public interest has led to the creation of a committee on air pollution to investigate prevention and to recommend abatement laws and regulations. Although air pollution in Norway is not as serious as in other countries, it is a considerable nuisance. The most serious problems are caused by the location of industry in deep valleys on the coast. A ust fall survey in Oslo showed 20 to 55 per cent of the average values found in London. The amount of dust and ash decreased in December and increased in April, when the snow melted, leaving the sand and gravel exposed. Since 1958, air pollution has been measured at 11 sites by smoke filters (reflectometer readings), volumetric sulfur dioxide apparatus (titration of total acidity following absorption in peroxide solution), and tarry matter fluorescence measurements. The pollution varied markedly in the winter due to high fuel consumption for domestic heating. Also, pollutants accumulated during the winter in calm weather and with inverse vertical temperature gradient. The use of hydroelectric power should reduce pollution.

33425

Tebbens, Bernard D.

GASEOUS POLLUTANTS IN THE AIR. In: Air Pollution. Arthur C. Stern (ed.), Vol. 1, 2nd ed., New York, Academic Press, 1968, Chapt. 2, p. 23-46. 45 refs.

Gaseous pollutants that may be present in the air are described, and the expression of gas concentration, the importance of averaging the time on air quality data, the components of normal air, and the effect of water vapor from air pollution standpoint are discussed. Carbon dioxide concentration has been suggested as an index of the total amount of combustion and natural ventilation in an urban environment, but the CO2 level in any area where vegetation is plentiful has typical diurnal and seasonal variations. Carbon monoxide, emitted by internal combustion engines, is found in the greatest concentrations where traffic is heaviest. The lack of information of CO concentrations stems from its lack of effect on any of the human senses. Hydrocarbons are also present in the atmosphere, including oxygenated hydrocarbons such as the aldehydes. Sulfur dioxide is more prevalent in the air than sulfur trioxide, while hydrogen sulfide is an occasional air pollutant, known for its unpleasant odor. Mercaptans are among the odorous gaseous by-products of the kraft pulping industry. Continuous monitoring has shown that nitrogen dioxide predominates during nighttime, while during the day NO and nitrogen dioxide may be equally abundant. The recognition of peroxyacetyl nitrate as a serious phytotoxicant has stimulated intensive study, employing very sensitive chromatographic procedures for identification and quantitation of PAN. The presence of ozone, oxidants, and fluorides in the atmosphere is briefly discussed.

33576

Hyogo Prefecture (Japan), Dept. of Living

PUBLIC NUISANCE IN HYOGO PREFECTURE. (Hyogo-ken no kogai). Text in Japanese. 197p., Nov. 1970.

The degree of air pollution in most cities in Hyogo Prefecture has stayed on the same level or increased slightly in recent years, except for Himeji and Akashi cities. Prevalent pollutants in Hyogo cities are carbon monoxide, nitrogen oxides, hydrocarbons, and oxidants created by the photochemical reactions of these material. Standard permissible and actual counts of sulfur oxides, CO, NO, NO2, suspended and settling particulates, lead, and fluoride, compounds are presented in description, tables, and graphs. Average amounts of settling particulates in Hyogo Prefecture run between 5.30 t to 14.52 t/k sq m/month; the highest figure is for Amagasaki city. Kobe city is the next most polluted; measurements at four locations all indicate more than 10 t/month average. The annual average for Kobe in 1967 was 12.78 t; in 1968, 12.54 t and in 1969, 12.87 t. At the highest point in an industrial area of Kobe, settling particulate averaged as high as 17.95 t/month. The annual average of sulfur oxides in Amagasaki in 1968 was 0.083 ppm/hr and in 1969, 0.084 ppm, representing a much higher figure than the maximum permissible amount of 0.05 ppm. Carbon monoxide concentration is 5.0-9.0 ppm/day in Kobe, 2.7-5.8 ppm in Himeji, and 2.3-6.8 ppm in Itami. Monthly averages of NO concentration in Kobe are 80-142 ppb and of NO2, 33-37 ppb. Figures in Himeji, Kakogawa, and Itami are much lower than those of Kobe. Western Hyogo around Akashi, Kakogawa, and Himeji are relatively unpolluted. The Himeji area has especially shown a marked improvement since dust collectors were installed in electric furnaces of iron foundries in 1967. The annual average of settling particulates of 11.12 t/k sq m/month in 1966 decreased to 7.92 in 1967, 6.54 in 1968, and 5.64 in 1969.

33858

Heaney, Robert J.

DISTRIBUTION OF TRACE ELEMENTS IN THE VICINITY OF AN INTEGRATED PRIMARY COPPER PRODUCTION FACILITY. Preprint, Air Pollution Control Assoc., Pittsburgh, Pa., 31p., 1971. 4 refs. (Presented at the Air Pollution Control Association, Annual Meeting, 64th, Atlantic City, N. J., June 27-July 2, 1971.)

A comprehensive air surveillance network has been established near an integrated primary copper production facility to gather air quality data related to its emissions and those of other potential sources. The results form this sampling network are analyzed. Several types of air samplers were used in the study. Fluoride concentrations were monitored using calcium oxide or calcium formate-impregnated filter papers. Sulfur oxides were sampled with the lead peroxide-coated cylinder method. Dust was monitored using high volume and low volume filter samplers for suspended dust, and dust fall jars or adhesive papers for settling dust. Data from these samplers were analyzed in several ways: on a 10-year statistical basis to establish averages, ranges, and long-term trends and annual variations; on an average monthly basis to determine seasonal variations; and on a statistical basis to determine the approximate lognormality of the data. The data analysis indicates slight decreasing trends for copper and sulfur oxides and significant decreases for fluorides. Review of the monthly data shows the gaseous constituents, sulfur oxides and fluorides, are more subject to seasonal meteorological variations than the particulate constituents. There was an inverse relationship between suspended and settling dust, with the former being higher during the windier months and the latter during the more stable inversion months. Clear relationships were shown for concentrations of various constituents with distance from known sources. The analysis of statistical distributions showed that both gaseous and particulate matter-related constituents are approximately log-normally distributed. (Author abstract modified)

34008

Dimitriev, M. T.

A STUDY OF ATMOSPHERIC POLLUTIONS AND PHYSICOCHEMICAL PROCESSES PREVAILING IN THE ATMOSPHERE OF THE DDR. (Ieucheniye atmosfernykh zagryaznenly i fizikokhimicheskikh protsessov, proiskhodyashchikh v atmosfernom vozdukhe GDR). Text in Russian. Gigiena i Sanit., 36(7):84-87. 1971.

The main trends in the assessment and control of air quality in the Deutsche Democratische Republic are reviewed. Sulfur dioxide, sulfur trioxide, sulfuric acid, hydrogen sulfide, nitrogen dioxide, ozone, carbon monoxide chlorine, hydrogen fluoride, tetraethyl lead, benzo(3-4)pyrene, dust and soot levels constitute the main pollutants measured during continuous monitoring. The SO2 concentrations range from 0.03 mg/cu m, in the summer, to 0.32 mg/cu m in winter in the city of Berlin; these fluctuations are due to domestic heating. Automotive exhaust gases constitute the main source for NO2 pollution which reaches 0.5 mg/cu m during the morning and evening peak traffic hours. There are 16 stations for systematic monitoring of atmospheric ozone, SO2, dust, and radioactivity. Maximum ozone levels occur during May and June along with other peak photooxidant concentrations related to air pollution. Photochemical generation of ozone, formaldehyde, and other photochemical oxidants in the polluted air constitute an important research area. The popularity of the two-stroke vehicle in the DDR increases the amount of pollutants due to exhaust gas. Thus, benzo(3,4)pyrene and formaldehyde are 30 to 50 and three to five times higher, respectively, than emissions from four stroke vehicles. The exhaust gases from two-stroke vehicles contain 50 mg/cu m lead and the air in the urban areas contains 0.3 to 0.5 microgram/cu m Pb in the DDR. Dust levels vary from 0.1 to 3.0 g/sq m in the cleanest rural areas to between 25 and 120 g/sq m in the industrial areas, with an average of 13 g/sq m in Berlin. Interactions between aerosols and the solubility of these carcinogens in blood serum constitute another area of air pollution research in the DDR. The main research institutes are indicated.

25764

PUBLIC NUISANCE WHITE PAPER, 1971. (Kogai hakusho, Showa 46 nendo ban). Text in Japanese. 483p., July 10, 1971.

The state of air pollution in Japan is surveyed with respect to statistical data on concentrations of sulfur oxides, carbon monoxide, nitrogen oxides, suspended and settling particulates, and specific toxic materials (hydrogen fluorides and hydrogen cyanides). Local conditions are discussed with emphasis on areas with complex and acute air pollution problems, such as the Tokyo-Yokohama and Osaka-Amagasaki areas; specific industrial developments, e.g., Fuji, South Nagoya, Yokkaichi, North Kyushu, and Omuta; and areas where pollution is rapidly increasing due to the development of large-scale industrial complexes, such as Tomakomai, Kashima, Chiba-Ichihara-Kimizu, Mizushima, and Oita. Damages caused by air pollution and effects on human health and agricultural and forestry produce are discussed. Governmental means of control, the nation-wide network of pollutant measuring devices, and local and regional surveillance systems are reviewed. The policy on desulfurization and acquistion of

low-sulfur fuels is outlined. Indirect control measures included a bufferdgreen area development plan, large-scale heating-cooling systems instead of individual home or building systems, and construction of collective high stacks. The offensive odor control bill is summarized.

36806

Tairafune, K., A. Sato, W. Nakano, and M. Takahashi

INVESTIGATION ON THE AIR POLLUTION IN MIYAKO DISTRICT. (Kwateken Miyako chiku no taiki osen ni tsuite). Text in Japanese. Taiki Osen Kenkyu (J. Japan Soc. Air Pollution), 6(1):191, 1971. (Presented at the National Council Meeting of Air Pollution Studies, 12th, Nagoya, Japan, Oct. 27-29, 1971.)

The concentrations of sulfur dioxide, nitric oxide, nitrogen dioxide, hydrogen fluoride, suspended particulate matter, and its metal components (cadmium, manganese, copper, and lead) were measured at six locations in Miyako City for seven days in Aug. 1970. The maximum SO2 concentration was 0.095 ppm, however, 98% of the measured value was less than 0.05 ppm. The mean NO and NO2 concentration was 0.01 ppm except at one location, which was presumably attributable to the effect of wind direction. The mean HF concentration was 1.6 ppb, and the mean concentrations of metallic components were (in micrograms (cu m): Cd, 0.11-0.15; Mn, 0.11-1.11; Cu, 0.10-0.84 Pb, 0.06-0.93.

37473

Waldbott, G. L.

AIRBORNE FLUORIDE IN THE LAKE ST. CLAIR-DETROIT RIVER AREAS. Fluoride, 4(2):93-96, April 1971. 6 refs.

A study of air pollution in the Lake St. Clair-Detroit River area was undertaken by a special board at the request of the International Joint Commission representing the governments of Canada and the United States. Of the 80 sampling stations set up, five monitored airborne fluorides -- two in the Port Huron/Sarnia area and three in the Detroit/Windsor area. The maximum recorded F(-) values ranged from 1.3 ppb in Port Huron/Sarnia samplings to 2.9 ppb at Grosse Isle, Michigan. In comparison, the highest level obtained by the National Air Sampling Network in 1966 and 1967 was 2.4 ppb. Gladioli planted at five locations had F(-) levels of 25-50 ppm. Tip and margin burns occurred within five weeks after the gladioli were planted. Before these findings can be applied to the evaluation of the health effects of F(-) on humans, consideration should be given to such variables as duration and continuity of sampling, height of sampling stations and their distance from emitting sources, and F(-) levels in soil and edibles. (Author abstract modified)

37502

Hokkaido Prefectural Government (Japan), Dept. of Hygiene

REPORT ON RESULTS OF INVESTIGATION AND ESTIMATION OF AIR POLLUTION. REPORT 7. (Hokkaido no taiki osen chosa sokutei kekka hokoku. Dai 7 ho). Text in Japanese. 25p., Feb. 1971.

The survey results of air pollution for 1969 in main cities in Hokkaido (Muroran, Asahigawa, Kushiro, Obihiro, and Tomakomai) are indicated, and a trend of pollution in each city is summarized. The estimation results are shown by monthly averages of each estimated spot in each city for amount of falling dust and soot, concentration of sulfur oxides by the lead dioxide and conductivity methods, concentrations of floating dust and soot by the filter paper method and concentration of hydrofluoride by the alkali filter paper method; a wind distribution chart is also given. Asahigawa, Kushiro, and Obihiro constitute an urban pollution type and the source of pollution was considered to be heating systems in winter; Muroran and Tomakomai constitute an industrial pollution type and the source was a factory. The extent of the pollution was on the same level in falling dust and soot; the concentration of sulfur dioxide has increased in Asahigawa and Kushiro.

37607

Mathe, Peter

MUCH INDUSTRY AND LITTLE AIR. (Viel Industrie und wenig Luft). Text in German. Technische Umweltmag., no. 1:16-19, Feb. 1972.

Because of heavy industrialization, the Duisburg area already has a high background concentration of pollutants. Unfortunately a new industrial center is planned in the recreational area in the Northeast of Duisburg. In a residential area in the city the following pollutant concentrations were measured during the growing seasons of 1968 and 1969: fluorides had a diurnal average of more than 2 micrograms and a daily maximum concentration of more than 12 micrograms/cu m air, the chloride concentrations were 67 and 695 micrograms/cu m air, the sulfur dioxide concentrations were 130 and 244 micrograms/cu m. During 5.3 to 15.5% of the measuring time a concentration of 400 micrograms SO2/cu m was exceeded, during 2 to 4% of the measuring time of a concentration of 750 micrograms SO2/cu m air was exceeded. Standard deciduous trees showed clear to heavy injuries. The mortality rate was high. The green belt used as a recreational area by city residents shall now be destroyed by two large power plants, one aluminum plant, and one petrochemical plant.

37823

Voytov, V. T.

EVALUATION OF GASEOUS CONTAMINATION IN THE ELECTROLYSIS SHOPS OF THE BRATSK ALUMINUM PLANT. (Operativnaya otsenka zagazovannosti tsekha elektroliza na BrAZe). Text in Russian. Tsventn. Metal., no. 10:45-47, Oct. 1971.

The quality of the technological equipment was studied, and the contributions of human carelessness to air pollution were analyzed. Based on the weekly surveys of electrolyzers, burners, and exhaust fans, contribution indices were established for the different equipment and stages of technology. The number of non-hermetic electrolyzers was regularly determined. As a result of the steps taken, the number on non-hermetic electrolyzers dropped from 32.3% in Sept. 1969 to 15% in Feb. 1970. General improvement in air quality was reached, with concentrations below the threshold. Hydrofluoric acid and fluoride concentrations of 0.27 mg/cu m and 0.42 mg/cu m, respectively, were measured in Feb. 1970, against the maximum allowable values of 0.8 mg/cu m and 1 mg/cu m. In addition, drastic drop in the volume of atmospheric emissions was obtained.

37994

Yamaguchi Prefecture (Japan), Research Inst. of Health; Yamaguchi Prefecture (Japan), Section of Environmental Hygiene; Yamaguchi Prefecture (Japan), Section of Public Nuisance; and Kuga Health Center (Japan)

RESULT OF AIR POLLUTION RESEARCH AROUND B TREATMENT AND DISPOSAL PLANT FOR INDUSTRIAL WASTES. (B sangyohaikibutsu shorijo shuhen no taiki osen chosa seiseki ni tsuite). Text in Japanese. Yamaguchi-ken Eisei Kenkyusho Nenpo (Ann. Rept. Yamaguchi Prefect. Res. Inst. Health, vol. 13:78-79, 1971.

The industrial wastes of the B treatment and disposal plant of Kumate-cho consist of the last disposal substances from an oil refinery, an oil chemical factory, and other chemical factories. The research was carried out at four spots of the area on the 11th and 12th of Dec. 1970. A sequential air sampler was used to measure sulfur dioxide every hour. Nitric oxide, nitrogen dioxide, ammonia, and chlorine were measured every two hours, and fluorine and SO2 were measured every three hours. The SO2 concentrations averaged 71.6 ppm at the outlet of chimneys, and 2.06 ppm at the outlet of a gas and vapor separator. Most SO2 was exhausted from the chimney (averaged 0.005-0.006 ppm) (the highest concentration being 0.029 ppm) at the spot 40-100 m distant from the incinerator. Among nitrogen oxides concentrations, NO averaged 0.032-0.019 ppm, and NO2 was 0.033-0.031 ppm. As for NH3, Cl, F, and sulfate, 0.005 ppm of chlorine was determined and others were not found.

39054

Shimizu Municipal Office (Japan)

SURVEY REPORT ON ENVIRONMENTAL CONDITIONS (CONCERNING ATMOSPHERE). (Kankyo joken chosa hokoku (Taiki kankei)). Text in Japanese. Rept., 4-(1), 21p. March 1972.

The air pollution survey of Shimizu City, Shizuoka Prefecture has been going on since Sept. 1967. This report primarily deals with the survey results for Sept. 1970 through Aug. 1971 and briefly discusses on the trend for the past 4 yrs. Air pollutants centering around sulfur oxides are measured at 31 selected spots in the city. Settling dusts, sulfur oxides, and fluorides are measured. The results are broken down by the measuring spot, method, month, and season. Heavy oil fuel consumption as well as weather conditions during the period are also discussed. The FY 1970 heavy oil consumption is estimated at 585,000 kl, of which about 440,000 kl (76%) was consumed in Miho District and 100,000 kl (16%) in or about the municipal office area. The most prevailing wind was NE (18%), followed by NNE (14%), and ENE and SW, 6% each as in the preceding year. The year had 36 rainy days with rainfall amounting to 1,730.8 mm, compared with 1,015 mm in the previous year. The precipitating dust was 6.3 tons/sq m/mo in average at Shimizu Municipal Office, 7.0 t at the Miho Fire Station, and 6.1 t at the Sodeshi Citizens Hall, all indicating a decrease by 10-25% from the previous year. Results obtained by lead dioxide method indicated that the high-concentration pollution zones (12 mg sulfur trioxide/100 sq cm PbO2/day) observed in the previous year disappeared this fiscal year while the medium-concentration pollution (1.0 mg SO3/100 sq cm PbO2/day) expanded to engulf more areas. The annual average for 10 spots in Shimizu municipal area was 0.82 mg SO3/100 sq cm PbO2/day indicating a decrease from the previous year s 0.95 mg. Pollution with fluoride has been negligible with no notable change again this year. As to the 4-year trend of the pollutants, both the soluble and insoluble content of the precipitating dust decreased each year, while the pH value fluctuated with the highest recorded early in 1970. The 0.5-1.0 mg SO3/100 sq cm PbO2/day zone is expanding while the 1.5-2.0 mg zone remains the same or decreases.

39182

Bourbon, P.

ANALYTICAL PROBLEMS POSED BY POLLUTION BY FLUORINE COMPOUNDS. (Probleme analytique du dosage de l ion fluor). Text in French. National Society for Clean Air, London (England), Intern. Clean Air Congr. Proc., London, England, 1966, p. 174-176. (Oct. 4-7, Paper VI/6.)

Analytical problems from fluoride pollution are discussed; a critical analysis of air sampling methods is made. Discussions are illustrated by determinations carried out at 20 sampling locations situated at a 20 km radius around an aluminum factory of one of the Pyrenean valleys in France. Sampling methods focus the utilization of an impinger which is a modification of the Greenberg-Smith device and which allows accumulation of fluorine ions 70 ml of 0.1 N sodium hydroxide solutions with no dust or hydrogen fluoride interference. Determinations of F ion were made monthly. Fluorine containing dusts were determined at a 1.0 km radius around the factory whereby separation from hydrogen fluoride was carried out with Millipore filters (0.8 micron pores). These filters were utilized when sampling was made in dry weather conditions and heated air flows (80 C) were bubbled into NaOH- containing impingers. The amounts of HF carried along did not exceed 5.0% of the total amount of fluorine thus trapped. Additional information was obtained from F ion determinations carried out on rain water samples at the 20 pluviometer network installed at a 10 km radius around the factory. Determinations made once monthly according to the Spanos-Zirconium method showed only the presence of ionisable fluorine in the rain water. Of the thoroughly described sample preparation and analytical methods the Lanthane-Alizarine-complexone specrophotometric procedure was the best one for below 10 micrograms F ion in 50 ml aliquots. Average values (from 100 samples) showed F ion from hf to be 57% and F ion from dust to constitute 47%. The dust composition included coke, tar, aluminum trioxide (50-60% of the dust weight), sodium carbonate and sodium sulfate (traces), and fluorine compounds. Fluorine pollution ranged from 0-3.0 micrograms/cu m referred to as F ion. Amounts below the 10 micrograms/cu m level were the most frequent. Extreme values of 10 - 20 micrograms/cu m were found incidentally in the immediate vicinity of the plant under inversions.

39737

Sadtler (Sameul P.) and Son, Inc., Philadelphia, Pa.

SMOKE IN THE CUYAHOGA VALLEY OF CLEVELAND. 42p., 1950. 4 refs.

The air quality of the Cuyahoga Valley of Cleveland, Ohio was measured to determine the general atmospheric conditions with respect to smoke, dust, and fumes and to assess the extent of air pollution damage to health, plant life, and property. Qualitative analyses of the air determined various proportions of metal compounds, metal oxides, fluorides, hydrogen sulfide, phenols, silica, sulfur dioxide, hydrofluoric acid, sulfur compounds, nitrogen oxides, hydrocarbons, and heavy oils. Smoke shade was measured using the Ringelmann chart; visibility, dustfall, and haze were also monitored. The major sources within the area include blast furnaces, steel industries, coke works, sintering plants, open hearth furnaces, iron foundries, and electric furnaces. Various control methods are suggested.

40896

Renzanigo, F.

AIR POLLUTION IN THE CITY OF MILAN. OBSERVATIONS ON AN INVESTIGATION CARRIED OUT BETWEEN OCT. 1969 AND JUNE 1970 AND OCT. 1970 AND MAY 1971. (L inquinamento atmosferico della citta di Milano. Osservazioni su un indagine svolta nel periodo ottobre 1969 - Giugno e Ottobre 1970 - Maggio 1971). Text in Italian. Riv. Combust. (Milan), 26(1):22-35, Jan. 1972. 9 refs.

The contribution of heating to the air pollution in the city of Milan was studied between Oct. and June 1969-1970 and Oct.

and May 1970-1971 and related to the local meteorology and to the utilized fuel. Milan is a city characterized by large levels of atmospheric humidity and very scarse winds, reaching a maximum of six km/hr speeds. Domestic heating represents one of the main pollution sources in Milan, utilizing fuel oils with a 2.8% sulfur content or solid fuels such as coal, coke, and anthracite with a level of volatile compounds below 13%. Other pollutant sources contributing to the atmospheric quality of the city are metallurgical industries, emitting metal oxides, lead and zinc compounds, sulfur dioxide, and chlorine and fluorine compounds; petroleum processing emitting sulfur compounds, hydrocarbons, and particles; rubber processing industries, emitting sulfur and nitrogen oxides, and carbon monoxide. The program for air quality studies herein described includes the installation of five monitoring stations in different areas of the city. The facilities operate continuously for 8 days at a time, taking samples twice a day for 6 hr periods from 6 through 12 am and from 3 through 9 pm. Analytical determinations include gravimetric dust measurement, and their qualitative and quantitative composition study by means of X-ray fluorescence spectrometry, atomic absorption, and neutron activation techniques and total acidity expressed in SO2 and measured according to a British standard method. The variation in these two parameters related to temperatures and relative humidity if represented graphically. Peak values are usually reached during the December and January months, which coincide with the most persistent thermal inverstion seasons and decrease gradually from February through May. Cessation of heating leads to decreases in atmospheric SO2 from 0.54 ppm (Dec. 1969) to 0.02 ppm (June 1970. Dust decreases represent minor contrasts indicating the involvement of other important sources)automotive traffic, industries. The severe air pollution conditions during the winter season are attributed to the fuel factor and may be improved once the law regarding this subject is put into practice.

41979

Ibaragi Prefecture (Japan), Environmental Pollution Research Center

ANNUAL REPORT OF THE ENVIRONMENTAL POLLUTION RESEARCH CENTER OF IBARAKI-KEN NO. 3. (Ibaraki-ken kogai gijutsu senta nenpo). Text in Japanese. 162p., Aug. 1970.

Air pollution, noise and water quality in Ibaragi are discussed. Falling dust, sulfur oxides, and meteorological observation in Hitachi and Kashima areas are given. Waste gas of factories in 16 areas of Ibaragi Prefecture and odor in Kashima area are mentioned. Automobile exhaust gases in five cities whose street traffic is comparatively heavy was measured. Dust fall near a cement factory was heavy and the concentration of sulfur dioxide in the basin of the River Miyata was as high as in the preceding year. There was a large amount of dust fall in the Kashima area. This was caused by the sand dune zone around the area and the effect of various construction works in Kashima. The amount of smoke from some factories where several complaints were reported was over the emission standard of environmental pollution control regulations in Ibaragi Prefecture. Hydrogen sulfide, ammonia, SO2, methyl mercaptan, and hydrogen fluoride were the cause of odor. The concentration of carbon monoxide and the amount of lead in automobile exhaust was low in every area, compared with the degree of pollution in the main cities. Water quality of different rivers and drainage of factory sewage were surveyed and reported.

42760

Katz, Morris

THE ATMOSPHERIC POLLUTION PROBLEM IN CANADA. Chem. Can., 4(8):25-32, Aug. 1952. 67 refs.

In Canada, as in other countries, huge economic losses have been sustained by the unrestricted emission of excessive smoke, toxic gases, and particulate effluents from combustion, metallurgical, and other industrial operations. In agricultural and forest areas, extensive damage has been caused by the liberation of excessive quantities of sulfur dioxide, fluorine compounds, arsenical dust, and other effluents. In urban areas, the economic effects are evident in accelerated corrosion of metals, deterioration of stonework and other building materials, plant and household equipment, soiling and injury to textiles and other fabrics, and excessive laundry bills. The Trial smelter case and a current problem of urban pollution involving industrial wastes and smoke from vessel traffic in the Detroit River area are discussed. Other problems considered involve the nickel smelting district of Sudbury and the gold mining and smelting district of Yellowknife. Urban air pollution, sulfur dioxide pollution, and the distribution of particulate contaminants are considered, including the effects of air pollution on vegetation and human health. High stacks and meteorologic control are mentioned, as well as the removal and recovery of effluents. Emission standards are discussed.

43170

Garber, K.

AIR POLLUTION IN THE INDUSTRIAL SECTION OF HAMBURG AND ITS EFFECT ON VEGETATION. (Die Luftverunreinigung im Hamburger Industriegebiet und ihre Auswiskung auf die Vegetation). Jahresber. Staatinst. Angeu. Bot., Hamburg, vol. 83/84:158-173, 1966. 19 refs. Translated from German, 26p.

Three-year tests were conducted in the industrial section of Hamburg to ascertain the amount of atmospheric pollutants and their effect on vegetation. In addition, the results from other institutes were evaluated. The highest sulfur dioxide average values were .4-.5 mg SO2/cu m from a SW and WSW direction. The effect of emissions on vegetation was determined by means of plant tests in containers with uniform soil compared to control tests in nonindustrial areas. Chemical analyses showed test plants in industrial areas had sulfate contents 10 times as high as in nonindustrial areas while chloride and fluorine contents were only twice or three times as high. (Author abstract modified)

43317

Kagawa Prefecture (Japan)

INVESTIGATION OF ATMOSPHERIC AIR IN SAKAIDE AND MARUGAME AREAS. (Sakaide, Marugame chiku kankyo taiki chosa hokokusho). Text in Japanese. 127p., March 1972.

Measurements of meteorological conditions and atmospheric contaminants were carried out during the period from Nov. 6-13, 1971 in order to grasp the quality, quantity, and extent of air pollution in Sakaide and Marugame areas of Kagawa Prefecture and to obtain the data necessary for preventive measures. Meteorological studies were undertaken by recording wind vanes and anemographs at five spots. Oxides of sulfur were measured by sequential air samplers at 12 measuring spots around factory districts, and the collected gas was analyzed by the P-rosanilin method. Suspended particulates were continuously collected by high volume air samplers at 12 measuring spots for 7 days, and the quantity of suspended particulates, benzene soluble matter, water soluble matter, sul-

furic and nitric acid radicals, and metallic elements were analyzed. Oxides of nitrogen were measured by air samplers at six spots around the factory district for 8 hours a day for 7 days, and analyzed by means of the Saltzman method. Fluorine compounds were measured by low volume air samplers and the alkali filter paper method at five spots around the factories for 8 hours a day for 7 days. The amount and method of fuel consumption in industries were also examined.

44267

Tomakomai City Government (Japan) and Tomakomai Health Center (Japan)

ACTUAL SITUATIONS OF POLLUTION IN TOMAKOMAI CITY. (Tomakomai-shi ni okeru kogai chosa no genkyo (Showa-45-nen 1-gatsu - 12-gatsu)). Text in Japanese. 44p., March 1971.

The monthly amounts of dust fall, suspended dust, sulfur oxides by the lead dioxide method and by the electroconductivity method, fluorides by the alkaline filter method, water quality, and noise in Tomakomai City in 1970 were investigated. The concentrations of sulfur oxides were higher than those of the previous year at two spots in the city. Moreover, more than 0.2 ppm occurred for 7 hours among 4385 total hours at one spot; and 15 hours among 5412 total hours at the other. The increasing tendency of high concentrations of noxious gases in coastal industrial regions was also found. Water in Tomakomai Harbor is of good quality. Wind and other meteorological factors were also measured. Nitrogen dioxide and nitric oxide values are given.

44799

Graefe, Kurt

AIR POLLUTION MONITORING METHODS AND DETERMINATION OF AIR POLLUTANT-INDUCED EFFECTS. (Methoden der Luftueberwachung und der Wirkungsbestimmung von atmosphaerischen Schadstoffen). Text in German. Staedtehygiene (Uelzen/Hamburg), 21(8):190-192, Aug. 1970.

Air pollution monitoring methods as applied in West Germany, and studies on the effects of air pollutants are reviewed. Automatic multi-component monitoring with regard to carbon monoxide, carbon dioxide, sulfur dioxide, hydrogen sulfide, nitrogen oxides, hydrocarbons, chlorine, aerosols, wind velocity and direction, and vertical temperature distribution are being carried out in Leverkusen. Measurements in the equatorial regions of the Atlantic revealed a slight increase in the CO2 concentrations, and CO contents of 0.08-0.20 ppm. Forest damages due to aerosols were determined in coastal areas. Precipitation pH values of 4-5 and DDT concentrations of 1-3 ng/cu km in air were measured in Germany. Sulfur dioxide measurements at different altitudes in Munich revealed a maximum of 0.6 mg/cu m at 50 m height. Continuous measurements of SO2, CO, CO2, hydrocarbons, dust, wind speed and direction, as well as intermittent recordings of fluorides, chlorides, and ammonia are being run in Berlin. The SO2, CO2, and dust concentration variations showed good correlation. The use of automatic program control and data processing by means of on-line computer is being considered. Studies of air pollutant-induced effects will center on SO2, nitrogen dioxide, and respirable dust. Grass is regarded as an outstanding indicator plant.

47976

Ministry of International Trade and Industry (Japan)

A REPORT ON THE SURVEY OF THE ENVIRONMENTAL CONDITIONS OF THE CHIBA INDUSTRIAL AREA. (Chiba chiku konbinato kankyo hozen chosa hokokusho). Text in Japanese. 60p., Dec. 1972.

The air pollution conditions are improving gradually in the Chiba area. The averages of sulfur dioxide concentration in 1971 at 31 locations ranged from 0.035 ppm to 0.016 ppm, which was within the environmental standard. These results were brought about by the promotion of collectivization of stacks and high stacks, and the use of low sulfur fuels. Settling particle measurements at seven locations between 1969 and 1971 decreased gradually, especially at the most heavily polluted district in 1969, which dropped from 24.47 t/sq km/mo to 16.18 t/sq km/mo. Suspended particulates have not shown much improvement according to the measurements at seven locations. The morbidity of respiratory diseases of inhabitants were investigated in 1971 by the BMRC questionnaire, and a high morbidity rate was reported. In May 1972, detailed health examinations were initiated in heavily polluted areas; a city ordinance was issued on a relief program of health damages caused by air pollution. As of Aug. 10, out of 183 examinees (the total number to be examined: 753), 98 persons were diagnozed as patients, in the ratio of 37 chronic bronchitis, 45 bronchial asthma, seven asthmatic bronchitis, and nine emphysema cases. As for the damages on agricultural produce, fluoride damages on rice plants have been reported in July 1969 and 1970.

47982

Balabaeva, L. and G. Petrova

CONTAMINATION OF ATMOSPHERIC AIR WITH FLUORINE COMPOUNDS AND THEIR EXCRETION IN URINE OF PERSONS. (Zam rsyavane na atmosferniya v zdukh s fluorni c yedineniya i izl chyaneto im s urina pri khora). Text in Bulgarian. Khig. Zdraveopazyane, 15(2):162-168, 1972. 27 refs.

Silicon tetrafluoride (SiF4) and Hydrogen fluoride (HF) were determined in 349 and 347 air samples, respectively, taken in four locations of the Dimitrograd city area with a superphosphate and a cement producing industry. Samples were collected 5 days each month between March and November of 1970. Of 347 samples, 19.2% had an average of 0.011 to 0.013 mg HF/cu m exceeding by four times the maximum allowable concentration (MAC) value of 0.02 mg/cu m. Highest HF concentrations reaching 0.058-0.081 mg/cu m were found at locations closest to the superphosphate plant. Of the 349 air samples, 3.4% exceeded the SiF4 MAC of 0.02 mg/cu m and maximum figures ranged from 0.036 to 0.053 mg SiF4/cu m, while average values of 0.008 mg SiF4/cu m were found, generally. Urinary excretion of fluorine compounds in highschool students 12 to 14 years old exceeded 60 micrograms % in fluorine levels in 32% of the Dimitrovgrad city group, compared to an age-related group of children from Sofia with 42.8 micrograms % fluorine excretion.

48791

Hamamoto, H., H. Kono, S. Hattori, and A. Kanazawa

ENVIRONMENTAL POLLUTION BY FLUORINE IN THE TOMAKOMAI DISTRICT. (Tomakoamai-chiku ni okeru fusso no kankyo osen ni tsuite). Text in Japanese. Nippon Koshu Eisei Zasshi (Japan. J. Public Health), 19(10):422, Oct. 1972. (Presented at the Japan Society of Public Health, General Meeting, 31st, Sapporo, Japan, Oct. 25-27, 1972.)

In the Tomakomai region, fluorine compounds have appeared as atmospheric pollutants since aluminum refining ankd phosphate fertilizer manufacturing have begun. The ocean wind, from spring through summer, causes mobile inversion layers and occurrences of its typical smog. Fifteen measuring spots have been set within 7 km of the source. Measurements were made the first week of every month. Average values of these spots for 1971 and curved lines representing their

equivalent intensities are shown. The value within 1 km of the source is as high as 20 to 30 times the minimum value. All measured spots located NNE from the source and their year round averages are correlated. More than 91% of the polluted substances fall within 3 km of the source. Sulfur trioxide in April and fluorine in May and June had their peak values. At spots within 2 km from the source, where the fluorine concentration was over 10 micrograms/100 sq cm, plant damage occurred.

48850

Ehime Prefectural Government (Japan), Inst of Public Health; Ehime Prefectural Government (Japan), Bureau of Living Environment; and Ehime Prefectural Government (Japan), Niihama Health Center

A REPORT ON A SURVEY OF AIR POLLUTION IN THE EHIME PREFECTURE, REPORT NO. 1. (Ehime-ken taiki osen gaikyo hokoku, daiippo). Text in Japanese. 68p., Feb. 1972.

Results of air pollution measurements in various areas are given. The measurements of sulfur oxides, airborne particulate, hydrogen fluoride, nitrogen oxides, and oxidants were performed by conductivity and lead dioxide, light scattering, fluoride ion activity, colorimetry, and spectrophotometric methods, respectively. The condition of sulfur oxides pollution was classified into five degrees from under 1.0 mg SO3/day/100 sq cm PbO2 to above 4.0 mg SO3/day/100 sq cm PbO2. All locations except the industrial areas showed first to second degree SOx pollution. The SOx concentration in the industrial area was higher than the environmental standard value, but there was a decreasing tendency. The HF concentration in an aluminum refinery area was about 0.5 ppb/mo. The particulate concentration from the major cities in this area was below average compared to the major cities in other areas.

49118

Kagawa Prefecture (Japan)

THE RESULTS OF 1972 INVESTIGATIONS OF AIR POLLUTION AND WATER POLLUTION IN KAGAWA PREFECTURE. (Kagawa-ken) (Showa 47-nendo taiki osen, Suishitsu odaku chosa kekka). Text in Japanese. 59p., Dec. 1972.

Measurements were conducted for sulfur oxides concentrations at seven locations by the electric conductivity method and 45 locations by the lead dioxide method; for particulate concentrations at 18 locations by deposit gauges; and for fluorides concentrations at five locations. The sulfur oxides concentrations measured by the PbO2 method were classified into five degrees - from under 1.0 mg/100 cu m/day as slight pollution to over mg/100 cu m/day as severe pollution. The SOx concentrations measured by the conductivity method were all below the environmental standards. Among the 45 locations at which SOx concentrations were measured by the PbO2 method, only three locations had SOx concentrations slightly over 1.0 mg/100 cu m/day. Only one location had a particulate concentration over 10 tons/sq km mo. The hydrogen fluoride concentrations were also below the threshold values which would cause damage to plants.

49260

Nakagawa, Yoshihiro and Kokei Takata

ATMOSPHERIC FLUORIDE POLLUTION AROUND STEEL WORKS AND FERTILIZER PLANTS. (Seitetsu kojo oyobi seihi kojo shuhen chiku ni okeru fusso kagobutsu ni yoru taiki osen). Text in Japanese. Japan Society of Air Pollution, Proc. Symp. Japan Soc. Air Pollut., 13th, 1972, p. 189. 2 refs. (Nov. 7-9, Paper 144.)

As a simple method of estimating the degree of pollution, the water soluble fluoride content in suspended particulates were measured. Environments of a steelworks and a fertilizer plant were examined. The relationship between fluoride level and other pollutants was also examined. Hi-vol and low-vol samplers with glass fiber filters were used for sampling. The measurements were analyzed by a comparison with a fluorine ion calibration line. An ion strength adjustment buffer solution was used to give ion strength and to eliminate interference by ferrous aluminum. Of the 11 measuring points at the ironworks, the maximum concentrations were 464.5 micrograms/cu m of suspended particulates and 1.012 micrograms/cu m of soluble fluorides. Averages were 194.6 and 0.273 micrograms. Correlations among suspended particulates were: dusts 0.428, manganese 0.686, zinc 0.586, iron 0.563, lead 0.526, and cadmium 0.449. The highest amount of suspended particulates in the environment of the fertilizer plant was 184.8 micrograms/cu m, and fluorides 0.438 microgram/cu m; averages were 112.3 and 0.118. Significant correlations (1%) were recognized between fluorides and all other elements in the surroundings of the ironworks; but only 1% correlation between dusts and fluorides and 5% correlation between cadmium and calcium were recognized near the fertilizer plant.

49860

International Joint Commission, Ottawa (Ontario). St. Clair-Detroit Air Pollution Board

JOINT AIR POLLUTION STUDY OF ST. CLAIR-DETROIT RIVER AREAS FOR INTERNATIONAL JOINT COMMISSION. CANADA AND THE UNITED STATES. APTD-1305, 266p., Jan. 1971. 43 refs. NTIS: PB 212635

An air pollution emission and air quality inventory was conducted in the Port Huron-Sarnia and Detroit-Windsor areas of the United States-Canada borders. Data were collected on particulates, sulfur dioxide, hydrocarbons, dust fall, odors, fluorides, carbon monoxide, hydrogen sulfide, nitrogen oxides, and oxidants; trace metal concentrations in particulate matter; meteorological factors; seasonal variations; emission sources; and effects on vegetation and materials. Dispersion models were used to calculate pollutant transboundary flow and local pollution. Costs were calculated for implementing remedial measures. Based on the data, a transboundary flow was determined across both the St. Clair and Detroit River international boundaries. Transboundary and local pollution both exceeded the level that is detrimental to the health, safety, and general welfare of citizens and to property. An emission inventory was conducted on fuel combustion, refuse disposal, solvent losses, and point sources. Control methods and equipment are described for boilers, steel mills, cement plants, lime plants, fertilizer plants, grain handling, sugar companies, petroleum refineries, chemical plants, automobiles, power plants, and grey-iron foundries.

50307

Office of Air Programs, Research Triangle Park, N. C., Div. of Atmospheric Surveillance

AIR QUALITY DATA FOR 1968, FROM THE NATIONAL AIR SURVEILLANCE NETWORKS AND CONTRIBUTING STATE AND LOCAL NETWORKS. Pub-APTD-0978, 240p., Aug. 1972. 1 ref. NTIS: PB 213830

Air quality data for 1968 collected throughout the United States by the National Air Surveillance Network are presented. Data includes measurements of benzene-soluble organic fractions, including benzo(a)pyrene; inorganic nonmetallic ions, including ammonium, nitrates, sulfates, and fluorides; suspended particulate matter; metallic components of air samples including antimony, beryllium, bismuth, cadmium,

chromium, cobalt, copper, iron, lead, manganese, molybdenum, nickel, tin, titanium, vanadium, and zinc; soiling index; and gaseous pollutants, including carbon monoxide, nitric oxide, nitrogen dioxide, sulfur dioxide, total hydrocarbons, and total oxidants. Data are tabulated for urban and nonurban sites. Laboratory methodology and instrumentation are reviewed.

50550

Kitagawa, Y., T. Maeda, A. Furukawa, H. Ryomi, and M. Ito

ENVIRONMENTAL ATMOSPHERE SURVEY RESULT OF UBE-ONODA AREA. (Ube-Onoda chiku kankyo taiki chosa seiseki ni tsuite). Text in Japanese. Yamaguchi-ken Eisei Kenkyusho Nenpo (Ann. Rept. Yamaguchi Prefect. Res. Inst. Health), no. 14:65-71, Aug. 1972.

Sulfur dioxide, hydrogen fluoride, nitric oxide, nitrogen dioxide, and aerosols were measured in Aug. 1971 at two industrial areas of Ube and Onoda. Sulfur dioxide in Ube averaged 0.034 ppm downwind of industrial plants. The maximum concentration was 0.161 ppm. In Onoda, the area affected by cement and sulfuric acid factories had a 0.040 ppm SO2 concentration. The maximum concentration was 0.164 ppm. The NO and NO2 concentrations were higher downwind of factories, but not as conspicuously as in the case of SO2, perhaps due to automobiles. No correlation between SO2 and the nitrogen oxides was found. The NOx concentrations were higher in the afternoon than morning; NO2 reached 0.03 ppm between 1 and 4 pm. Hydrogen fluoride was higher when the measured area was downwind of industries; the daily average was 0.006 ppm. Average aerosol concentration at Ube, which has large-scale cement, iron, and fertilizer plants, was 88 micrograms/cu m, ranging from 51 to 126 micrograms. Onoda had an average of 187 micrograms/cu m, ranging from 103-266 micrograms. There was no significant correlation between SO2 and aerosol. Sulfate and nitrate were also measured.

50690

Lahmann, E.

RESULTS OF SPECIAL CHEMICAL INVESTIGATIONS OF THE AIR IN THE UNTERMAIN REGION. In: Lufthygienisch-meteorologische Modelluntersuchung in der Region Untermain. 4. Arbeitsbericht. Regionale Planungsgemeinschaft Untermain Frankfurt am Main (West Germany), p. 61-75, Oct. 1972.

The average and maximum sulfur dioxide, nitrogen dioxide, phenol, fluoride, dust, lead, chloride, and formaldehyde concentrations for April 1971 to March 1972 are listed in a table for the untermain region around Frankfurt. The measurements were taken at 43 sites. The average concentrations Of pollutants at the sampling sites are represented graphically on maps. Eight tables contain the frequency distribution of all measured values of the individual substances for various concentration categories. Another table shows the average values of pollutant concentrations for each day. The following peak average values per day were found: sulfur dioxide 222 micrograms/cu m, nitrogen dioxide 122 micrograms/cu m, phenols 13 micrograms/cu m, fluoride 2.23, formaldehyde 25, chlorides 57, dust 620, and lead 5.18 micrograms/cu m. In the winter months October the concentrations of sulfur dioxide, phenol, dust, and lead were higher than the concentrations of sulfur dioxide, phenol, dust, and lead were higher than the concentrations in the summer months. For nitrogen dioxide and formaldehyde it was the other way around. No points of especially high concentration could be found for phenols, fluorides, or formaldehyde. For chlorides, nitrogen dioxide, and sulfur dioxide the highest concentrations occurred in the city of Frankfurt.

50744

Saito, Kazuo and Tokihiko Mizobuchi

INVESTIGATION OF DUST FALL. (Koba baijin chosa ni tsuite). Text in Japanese. Nara-ken Eisei Kenkyusho Nenpo (Annu. Rep. Nara Prefect. Inst. Pub. Health), no. 6:136-141, Feb. 1973. 5 refs.

Dust fall was measured at five spots in Nara Prefecture for a month. Dust averaged 5.42 t/sq km/mo at one slightly contaminated spot. Dust fall was 4 t/sq km/mo at the other four spots, which is light contamination. Dust was generally acidic. Sulfuric acid, hydrochloric acid, hydrofluoric acid, and nitric acid, occurred in rainwater.

51929

Mizutani, Hiroo, Akio Kanaya, and Toyomasa Kato

SOME CONSTITUENTS OF AIR BORNE PARTICULATES IN NAGOYA SOUTHERN INDUSTRIAL AREA. (Nagoya-shi nanbu kogyo chiiki ni okeru taikichu fuyu funjin-chu no kagakuteki seibun ni tsuite). Text in Japanese. Nagoya-shi Kogai Kenkyusho (Rep. Environ. Pollut. Res. Inst., City Nagoya), no. 1:15-18, Nov. 1972. 4 refs.

Suspended dust, heavy metals, tars, and water-soluble dust content were measured in Nagoya city from March 11 to 22, 1972 at two locations in the center of the industrial area and one location in Minami Ward. Dust was collected with a hi-vol air sampler; heavy metals in the dust were extracted and analyzed by atomic absorption spectrophotometry. Tar was extracted with acetone; water-soluble constituents were extracted with distilled water to analyze sulfates, nitrates, fluorides, and chlorides. The highest dust concentration was 1078.3 micrograms/cu m in the industrial area. Heavy metals included iron, manganese, copper, lead, and cadmium. The nitrate concentration was about half the sulfate concentration at both measuring stations in the industrial area.

52575

Yunghans, R. S. and T. B. McMullen

FLUORIDE CONCENTRATIONS FOUND IN NASN SAMPLES OF SUSPENDED PARTICLES. Fluoride, 3(3):143-152, July 1970. 8 refs.

Samples of suspended particles collected at various urban sites in the National Air Sampling Network were analyzed for contents of the fluoride ion. Of the over 7700 measurements, 87% were at fluoride concentrations below 0.05 micrograms/cu m, i.e., the threshold of detectability; 0.2% exceeded 1.00 micrograms/cu m, with 1.89 micrograms/cu m as the maximum; and 0.2% exceeded 0.10 micrograms/cu m. Ninety-seven percent showed no detectable amounts of the fluoride ion. The maximum levels were well below most of the published standards for a 24-hour average concentration. (Author summary modified)

52578

Blosser, E. R. and W. M. Henry

IDENTIFICATION AND ESTIMATION OF IONS, MOLECULES, AND COMPOUNDS IN PARTICULATE MATTER COLLECTED FROM AMBIENT AIR. (FINAL REPORT). Battelle Memorial Inst., Columbus, Ohio, Columbus Labs., Air Pollution Control Office Contract CPA 70-159, Rept. APTD-0705, 77p., July 23, 1971. NTIS: PB 201738

The inorganic components of particulates in ambient urban air were qualitatively and quantitatively determined from samples collected on millipore and glass filters in Cincinnati, Denver, St. Louis, Washington D. C., Chicago, and Philadelphia. Analytical techniques included chemical analysis, including

atomic absorption spectrophotometry, colorimetry, and combustion analysis; optical emission spectrography; spark-source mass spectrometry; X-ray fluorescence; combination mass spectrometry- vacuum fusion; and direct vacuum fusion extraction. The samples were analyzed for contents of all the metal compounds, arsenic, bromine, chlorine, fluorine, hydrogen, iodine, nitrogen, oxygen, phosphorus, selenium, silicon, carbon, and sulfur.

52811

Davison, A. W., A. W. Rand, and W. E. Betts

MEASUREMENT OF ATMOSPHERIC FLUORIDE CONCENTRATIONS IN URBAN AREAS. Environ. Pollut., 5(1):23-33, 1973. 14 refs.

Coal and shale are recognized sources of fluoride pollution in Great Britain, but little is known about ground level concentrations in coal-burning areas. A high-volume sampler powered by a portable generator was tested and used to measure fluorides in local mining villages. Modal concentrations were less than 0.05 and about 0.3 micrograms/fluorine/cu m at rural and urban sites, respectively. Concentrations were locally very high near burning pit heaps. Partition of the fluoride using a citric acid impregnated pre-filter showed that most was in a gaseous and therefore phytotoxic form. It is suggested that fluoride concentrations from burning coal could be sufficiently high to damage sensitive plants and could contribute to fluorosis. (Author abstract modified)

53889

Hirosawa, Iichiro

REGIONAL POLLUTION BY EMITTED GASES OF ALUMINUM REFINERY. (Aruminyumu seiren kojo haigasu ni yoru chiiki osen). Text in Japanese. Kogai to Taisaku (J. Pollution Control), 9(4):347-351, April 1973. 6 refs.

An aluminum refinery in Japan yields 1,900,000 tons of products a year and emits fluoride compounds. It is located in a long narrow valley with largely southerly winds. Fluorides were measured in red pine leaves and in the ambient air. The leaves were dried, ashed, and analyzed by spectrophotometry. The area to the east of the refinery had an air fluoride content of 20-30 micrograms; the area to the north had 70-80 micrograms of fluoride in the air. The winter had values three or four times larger than the summer. The fluoride content in pine leaves 1 km from the refinery was 150-300 ppm. The northern area had slightly larger values than the southern areas. Plants growing in the northern area had greater damage than those in the southern area.

54881

Fukushima Prefecture (Japan), Office for Environmental Pollution Regulation

PRESENT SITUATION AND CONTERPLAN FOR ATMOSPHERIC POLLUTION IN FUKUSHIMA PREFECTURE. (Fukushima-ken no taiki osen no genjo to taisaku). Text in Japanese. Taiki Osen Nyusu (Air Pollution News), no. 78:2-8, Sept. 1973.

The Iwaki district, comprised of factories, chemical plants, fish processing plants, and power plants, was examined. Falling smoke dust, sulfur oxides, and acidic substances were monitored. Sulfur oxides decreased in 1965-1967 increased to peak in 1969, and are decreasing again. Higher pollution appeared near the plants, during spring to autumn, and on windy days. During 1972, seven out of 21 sites were above the maximum allowable concentrations. In the Onahama district, faulty land developments cause problems for living and industry. In the Aizu district, a smelting plant is the only emission source. Cadmium pollution and SO2 emissions are high, but are being improved. Dust and fluoride pollution exist in the Koriyama and Kitagawa districts. A power plant is under construction in the Soso district.

55187

Office of Air and Water Programs, Research Triangle Park, N. C., Office of Air Quality Planning and Standards

AIR QUALITY DATA FOR NONMETALLIC INORGANIC IONS 1969 AND 1970 FROM THE NATIONAL SURVEILLANCE NETWORKS. APTD-1466, 79p., June 1973. 3 refs. NTIS: PB 223630

Particulate pollutant data gathered during 1969 and 1970 by the cooperating stations of the National Air Surveillance Networks provide the basis for listing the urban and nonurban concentrations of four nonmetallic inorganic ions: ammonium, fluoride, nitrate, and sulfate. Laboratory methodology for each nonmetallic inorganic constituent is described. The data for ammonium, nitrate, and sulfate are presented as cumulative frequency distributions. Because there were no nonurban fluoride measurements above the detectable concentration, the table showing nonurban concentrations of fluoride is abbreviated. (Author abstract modified)

56463

Emler, V. S. and S. H. Hullett

PORTSMOUTH GASEOUS DIFFUSION PLANT: ENVIRONMENTAL MONITORING REPORT -- 1972. In: Environmental Monitoring At Major U. S. Atomic Energy Commission Contractor Sites Calendar Year 1972. Goodyear Atomic Corp., Piketon, Ohio, Atomic Energy Commission Contract AT-(33-2)-1, Rept. GAT-740, TR-021973-SAJ, p. 957-974, Feb. 28, 1973. 4 refs. NTIS: WASH 1259

Environmental monitoring data of both radioactive and nonradioactive pollutants are presented for the Portsmouth Gaseous Diffusion Plant located in Pike County, Ohio for the year 1972. The principal process in the plant is the separation of uranium isotopes through gaseous diffusion. Maximum concentrations of alpha and beta-gamma activity in the air were only 10.1 and 0.5%, respectively, of the applicable radioactivity concentration guides. Average ambient air concentrations for fluorides were no higher than 2.6 ppb. Annual average sulfur dioxide concentrations were all below the national secondary air quality standard, 60 micrograms/cu m. Concentrations for particulate matter ranged from 6.7-733 micrograms/cu m, and the annual geometric mean for the year was 145 micrograms/cu m. The particulate samples were collected only directly downwind from the steam plant; thus, the exceeding of the 60 micrograms/cu m standard was not surprising since it did not truly represent an average.

56464

Union Carbide Corp., Oak Ridge, Tenn., Nuclear Div.

ENVIRONMENTAL MONITORING REPORT: UNITED STATES ATOMIC ENERGY COMMISSION OAK RIDGE FACILITIES, CALENDAR YEAR 1972. In: Environmental Monitoring At Major U. S. Atomic Energy Commission Contractor Sites, Calendar Year 1972. Rept. UCC-ND-244, p. 889-929, March 26, 1973. 9 refs. NTIS: WASH 1259

Environmental monitoring data are presented for the Atomic Energy Commission s Oak Ridge Reservation which includes facilities involved in nuclear research, the enrichment of uranium hexafluoride in the uranium-235 isotope, and weapon production and support activities consisting of the production

and recovery of compounds and the fabrication of metal materials. Data on the concentrations of radioactive materials in air of the surrounding areas indicated an average gross beta radioactivity from particulates in the air of 0.08% of the applicable concentration guide specified in the AEC Manual, Appendix 0524. The average gross alpha concentrations were 0.13% or less than the concentration guide for natural uranium, and the average concentration of (131)iodine measured by a perimeter air monitoring system was less than 0.01% of the inhalation concentration guide for individuals in uncontrolled areas. Average concentrations for fluorides, reactive sulfur, dust fall, and suspended particulates did not exceed the applicable standards.

56465

Union Carbide Corp., Oak Ridge, Tenn., Nuclear Div.

ENVIRONMENTAL MONITORING REPORT: UNITED STATES ATOMIC ENERGY COMMISSION PADUCAH GASEOUS DIFFUSION PLANT, CALENDAR YEAR 1972. In: Environmental Monitoring At Major U. S. Atomic Energy Commission Contractor Sites, Calendar Year 1972. Rept. UCC-ND-245, UC11, p. 931-955, 1973. 6 refs. NTIS: WASH 1259

Environmental monitoring data are presented for the Paducah Gaseous Diffusion Plant located in McCracken County, Kentucky for the year 1972. The plant is engaged in operations involving uranium enrichment cascade with associated uranium hexafluoride manufacturing. Air analyses for alpha and beta radioactivity averaged less than 1% of the applicable Radioactivity Concentration Guide for all off-site sampling stations. Air and grass off-site analyses for fluorides met the Kentucky air quality requirements. Data was also collected for water and soil samples.

56792

Environmental Protection Agency, Research Triangle Park, N. C., Air Pollution Control Office

MOUNT STORM, WEST VIRGINIA-GORMAN, MARYLAND, AND LUKE, MARYLAND-KEYSER, WEST VIRGINIA, AIR POLLUTION ABATEMENT ACTIVITY. (PRE-CONFERENCE INVESTIGATIONS). APTD-0656, 133p., April 1971. 63 refs.

An air pollution investigation was conducted in the Mt. Storm, W. Va.-Gorman, Md., and Luke, Md.-Keyser, W. Va. areas in 1969 and 1970. The major problem in the Mt. Storm-Gorman area is air pollution related damage to commercial Christmas tree growing operations. Air quality measurements were made for sulfur dioxide, nitrogen dioxides, oxidants, particulate matter, and fluorides. A review of the vegetation damage (discoloration, browning of needles, tip burns, poor foliage) suggest that SO2, ozone, and settling particulates are of primary concern. The major sources of SO2 and particulate matter are the Mt. Storm Power Plant and the Westvaco pulp mill. There are three power plants outside the area that could have an appreciable affect on air quality. The relatively high O3 source is not established. The air pollution problems in the Luke and Keyser area are caused by particulate matter and noxious sulfur gases released from industrial plants. A pulp and paper mill operated by the Westvaco Corp. is the primary source of air pollutants. A control program will not be achieved until 1975 or 1976. A number of smaller sources include a coal washing plant, a charcoal plant, and a gob pile. Additional information for both areas include: history of problem, Federal abatement activity, geography, climatology, and air pollution meteorology.

58218

Lee, Robert E., Jr., Jim Caldwell, Gerald G. Akland, and Robert Fankhauser

THE DISTRIBUTION AND TRANSPORT OF AIRBORNE PARTICULATE MATTER AND INORGANIC COMPONENTS IN GREAT BRITAIN. Preprint, Environmental Protection Agency, Research Triangle Park, N. C., National Environmental Research Center, 30p., 1973 (?). 14 refs.

Daily measurements of total suspended particulate matter, sulfate, nitrate, ammonium, and fluoride components were made during the heating and nonheating season at six primary and five secondary sites in Great Britain. Samples were collected with high volume air samplers operating for 24-hour periods. The degree of association between the inorganic components were markedly influenced by the total suspended particulate concentration, and a strong relationship was found between sulfate and ammonium concentrations at the primary sites. Wind direction was the most important factor in the particulate concentration levels in Great Britain; and during stagnation conditions or when the wind was predominantly from an easterly or southern direction, i.e., from the northern European continent, particulate levels were highest. Particulate levels were the lowest when the wind was predominantly from a westerly direction, i.e., the Atlantic Ocean. The particle sizes of the total suspended particulates and aerosol components appeared to be sufficiently small to account for their long-distance transport from sources outside of Great Britain. (Author abstract modified)

58339

Tsunoda, Fumio, Ikuko Aizawa, and Shiro Sakurai

CONCENTRATION OF FLUORIDE IN THE AIR OF VARIOUS COMMUNITIES IN JAPAN. (Honpo kakuchi ni okeru taikichu fukkabutsu nodo ni tsuite). Text in Japanese. Taiki Osen Kenkyu (J. Japan Soc. Air Pollution), 8(3):496, Oct. 1973. (Presented at the Japan Society of Air Pollution, Annual Meeting, 14th, Fukushima, Japan, Nov. 6-8, 1973, Paper 226.)

The gaseous fluoride, and water soluble and nonsoluble fluoride particle concentrations in the atmosphere were measured separately at 30 locations including Osaka, Kawasaki, Yokohama, aluminum refining industry areas, ceramic industry areas, ceramic industry areas, ironwork areas, regional industry areas, and commercial areas. Millipore filters and sodium carbonate soaked filters were used for sampling the atmosphere. Gaseous fluoride was extracted by warm water from the treated filter; particles were extracted by warm water; nonsoluble particles were measured by burning the filter after the solubles were extracted and distillating it by sulfuric acid steam. Fluorine ion electrodes were used for quantitation. The measurements in the neighborhoods of aluminum refining industries ranged from 0.03 to 4.02 micrograms F/cu m in total amount, with rather high ratios of soluble particles. In ceramic industrial areas, the total fluorides ranged from 0.05 to 2.16 micrograms/ F/cu m, and the ratio of gaseous fluoride was overwhelmingly high.

58427

Ando, Asahiro, Kenichiro Terai, and Yoshikazu Nasu

AIR POLLUTION BY FLUORIDE IN HOKKAIDO TOMAKOMI DISTRICT. (Hokkaido Tomakomai chiku ni okeru fukkabutsu osen ni tsuite (Dalippo)). Text in Japanese. Taiki Osen Kenkyu (J. Japan. Soc. Air Pollution), 8(3):495, Oct. 1973. (Presented at the Japan. Society of Air Pollution, Annual Meeting, 14th, Fukushima, Japan, Nov. 6-8, 1973, Paper 225.)

As a preliminary study for an estimation for the proposed industrial site east of the present Tomakomai industrial belt, where annual production of one million tons of aluminum is expected, the extent of the present fluoridy pollution was investigated. The F content in the air was measured by the Hokkaido Government using alkaline filter paper, and the F content in plants was studied in red clover collected in July, August, and September of 1971 and 1972. The fluoride content in clover and the distance and direction from the emission sources showed direct linear relationships. The measurements by alkaline filter paper and the fluoride content in clovers agreed well, and the correlation was 0.981. Southeastern and southwestern winds dominate in summer in the area and fluorides disperse inland; seasonally it coincides with the period of plant growth. High F contents in plants extended 6 km to north and 2 km to east and west from the emission source.

60574

Lahmann, E.

SPECIAL STUDIES IN AIR CHEMISTRY. (Bericht ueber spezielle luftchemische Untersuchungen im Raum Untermain in der Zeit von April bis Juni 1971). Text in German. Regionale Planungsgemeinschaft Untermain, 4th Frankfurt am Main (West Germany), Lufthyg.-Meteorol. Modelluntersuch. Reg. Untermain, Frankfurt am Main, West Germany, 1971, p. 36-39. (Nov. 4-5.)

The layout and preliminary results of air pollutant concentration measurements performed in the Lower Main region from April until June 1971 within an air hygienic and meteorologic model study of that region are presented. Three test stations with automatic air sampling for 1 hr each at 15-hour intervals by means of impingers for chloride, fluoride, and phenol concentration measurements, and three laboratory vans for one random sampling per month at each of the 43 sampling sites were used for the air pollutant measurements. Dust and lead concentration measurements were done in samples collected at 3 to 5 sampling sites for one sample within 3 to 5 hr. The sampling sites were arranged radially with Frankfurt am Main as a center, at increasing distances from the center city to the periphery of the investigation area. The average concentrations of sulfur dioxide, nitrogen dioxide, phenol, fluoride, formaldehyde, chloride, dust, and lead concentrations, obtained at the different sampling sites, were in the respective ranges of 30-126, 14-80, 2-5, 0.7-3.6, 4-33 and 4-93 micrograms/cu m, 0.18-0.23 mg/cu m, and 1.19-1.47 micrograms/cu m, respectively.

61140

Tsunoda, Fumio

STUDIES ON FLUORINE. (Fusso ni kansuru kenkyu). Text in Japanese. Kankyo Hoken Reporto (Environ. Health Rept.), no. 26:77-81, Nov. 1973.

The procedure and results of an analysis of airborne fluorine compounds are reported. These are caught with two different kinds of filters and are classified into gaseous fluorine compounds, soluble particulate fluorine compounds, and insoluble particulate fluorine compounds. These are dissolved in suitable solvents and the eluted solutions are analyzed by the ion electrode method. The limit of this analysis is 0.02 microgram/cu m for gaseous fluorine and 0.01 microgram/cu m for particulate fluorine. Analyses have been made in Kawasaki City, Yokohama City, Niigata Prefecture, Gifu Prefecture, Osaka Prefecture, Matsuyama City, Sakaide City, Yatsudo City, and Kamaishi City.

62438

Bressan, D. J., R. A. Carr, P. J. Hannan, and P. E. Wilkniss

THE DETERMINATION OF TRACE METALS AND FLUORIDE IN MINERALOGICAL AND BIOLOGICAL SAMPLES FROM THE MARINE ENVIRONMENT. J. Radioanal. Chem., 19(2):373-381, 1974. 10 refs.

Neutron activation analysis was used to measure trace metals in dust collected over the Atlantic Ocean, and photon activation analysis was used to measure fluoride in the dust. Mercury was also analyzed by neutron activation, but in a slightly different way. The results are presented for samples from the Atlantic, the Carribean, the Greenland Sea, the Pacific, and near the east coast of the U. S. Results agreed well with those done by other methods. The composition of the dust was close to the composition of average crustal rocks, thus agreeing with the contention that most dusts were from the continents or from volcanic eruptions. Instrumental neutron activation analysis of mercury presented some difficult problems. Despite the uncertainty of a 30% error, it was apparent that mercury concentrations in atmospheric dust exceeded those found in average crustal rocks (0.08 ppm) by about two orders of magnitude. The levels of fluoride lent additional support to the dust s continental origin, since fluoride content exceeded that of sea salt in air by a factor of more than 10. Mercury uptake by marine algae was also studied. In the radiotracer experiments, neutron activation analysis was used to determine the mercury content of the algae. The research methodology, results, and problems of the study are described. The amounts of mercury determined ranged from 10 to 40 micrograms.

63186

Lahmann, E.

AIR QUALITY MEASUREMENTS OF THE INSTITUTE FOR WATER-, SOIL-AND AIRHYGIENE. In: Air Hygienic Meteorological Model Studies of the Lower Main Region. Report 5. Regional Planning Assoc., Lower Main Region, Frankfurt am Main (West Germany), p. 100-115, June 1974.

At three measurement stations in the center of Frankfurt, in the east of Frankfurt, and in Hattersheim air was drawn for one hour through an impinger and the concentration of chloride, fluorides and phenols determined. For measurements of the dust concentration high volume samplers were used. The lead analyses of the dust were carried out by atomic absorption spectrometry. In addition the sulfur dioxide and oxides of nitrogen concentrations were determined in random samples. In the year 1972/73 the maximum daily average of SO2 was 201, of nitrogen dioxide 81, of phenol 13, of fluoride 0.98, of formaldehyde 23 of chloride 30, of dust 730, and of lead 7.51 micrograms/cu m. The annual average concentration of SO2 was 71, of NO2 48, of phenol 6, of fluoride 0.45, of formaldehyde 5, of chloride 16, of dust 220, and of lead 7.51 micrograms/cu m. The emissions measured in 1972/73 were in most cases lower than during the previous year. This is true for both the annual averages and the maximum daily averages. Of the pollutants, only SO2 was clearly higher in the center of Frankfurt than at the other stations. Formaldehyde exceeded, in two instances, the existing long-term maximum allowable emission concentration of 30 micrograms/cu m.

63526

Dyktor, H. G. and L. N. Goldston

THE EFFECTS OF THE STEEL INDUSTRY ON ATMOSPHERIC POLLUTION IN THE CLEVELAND AREA. Ind. Hyg. Newsl., 11(2):22-23, Feb. 1951.

Dust and gaseous pollutants in the air over Cleveland were measured during a steel strike in 1949 when the plants were

closed and after the plants reopened to determine the effects of the steel industry on pollution. The monitoring program is reviewed including sampling methods, sampling procedures, and results. Sulfur dioxide concentrations during the steel strike ranged from 0 to 0.389, but one sample was 0.290-0.389 ppm in the southern area of the valley. After the strike, the range was 0-0.489, and only one sample was in the range of 0.390-0.489 ppm in the northern area of the valley. Mean SO2 concentrations during the strike and poststrike periods were, respectively 0.034 and 0.050 ppm. Fluorides during the strike were 0-50 micrograms; after the strike the range was the same. The mean fluoride concentrations, respectively, were 11.59 and 11.12 micrograms/cu m. While these contaminants did not seem to have been affected much by the absence or the presence of steel-making activities, there was an appreciable effect on soiling caused by dust. The overall soiling range during the poststrike period was roughly 50% greater than during the strike.

66083

Okita, Toshiichi, Kazuko Kaneda, Takaaki Yanaka, and Ryuichi Sugai

DETERMINATION OF GASEOUS AND PARTICULATE CHLORIDE AND FLUORIDE IN THE ATMOSPHERE. Atmos. Environ., 8(9):927-936, Sept. 1974. 22 refs.

The measurement of gaseous and particulate chloride and fluoride in the atmosphere was accomplished using a combination of a Millipore filter and a sodium carbonate impregnated filter. The sampling flow rate was about 20 l/min, and the Millipore pre-filter was heated during the sampling. Hydrogen chloride and hydrogen fluoride were collected by a filter impregnated with 1% sodium carbonate and particulate and gaseous components of chlorides and fluorides were separated by aerosol filters in laboratory tests. The impregnated filter was also tested in a field study of gaseous and particulate chlorides and fluorides in Japan and Manila. The gaseous chloride concentration was high at the coast and on mountains, but the sources of the gaseous chloride concentration was obscure. The significance of sea salts, volcanoes, and man-made sources varied from place to place. Samplings of fluoride revealed that near and in an aluminum refining plant, the percentage of particulate component was higher than that of the gaseous component. (Author abstract modified)

67690

Hokkaido Government (Japan), Dept. of Health

REPORT ON THE AIR POLLUTION INVESTIGATION AND MEASUREMENT IN HOKKAIDO, REPORT NO. 10. (Hokkaido no taiki osen chosa sokutei kekka hokoku). Text in Japanese. 385p., Nov. 1973.

The air pollution measurements in five cities in Hokkaido are presented in tables. The measurements in Sapporo are not included in this report, but the reason is not given. Settling particles by deposit gauges were monitored at eight locations in Muroran, nine in Tomakomai, six in Asahigawa, three in Obihiro, and five in Kushiro. Fluoride was measured by alkaline filter paper at 13 locations in Tomakomai. Sulfur oxides are measured by lead dioxide at eight locations in Muroran, 25 in Tomakomai, 11 in Asahigawa, three in Obihiro, and five in Kushiro; sulfur dioxide is measured also by electroconductivity at four locations in Muroran, five in Tomakomai, one each in Asahigawa and Obihiro, and two in Kushiro. The measurements for 1972 are presented in tables and printouts. The PbO2 monthly averages of SOx in Muroran ranged from 0.3 to 1 mg/day/100 sq cm. The highest measurements were 1.4 mg in April and December at two different locations. The Tomakomai averages were from 0.11 to 58 mg/day/100 sq cm; the three other cities ran about the same figures. The fluoride pollution in Tomakomai was 0.11 microgram to 8.72 microgram/day/100 sq cm. The highest single average was 25.76 microgram/day 100 sq cm in August at one location, which also had a high figure of 23.91 micrograms in July, but as low as 0.61 micrograms in November. The reason is not clear. The most polluted city by settling particulates was Muroran, where in winter months, the dust accumulations were 99.8 tons or 100.8 tons/sq km/month.

69144

Heaney, Robert J.

DISTRIBUTION OF TRACE ELEMENTS IN THE VICINITY OF AN INTEGRATED PRIMARY COPPER PRODUCTION FACILITY. Preprint, Air Pollution Control Assoc., Pittsburgh, Pa., 31p., 1971. 4 refs. (Presented at the Air Pollution Control Association, Annual Meeting, 64th, Atlantic City, N. J., June 27-July 2, 1971, Paper 71-135.)

Sulfur oxide and particulate composition data are presented from air quality monitoring activities in the vicinity of an integrated primary copper production facility during the period 1959-1970. The average long term sulfur oxide concentrations ranged from 0.30-0.58 mg sulfur trioxide/day/sq dm. Suspended particulate levels of lead and copper ranged from 0.2-3.2 and from 0.3-0.8 micrograms/cu m, respectively. Settleable particulates ranged from 5-26 tons/sq mi/month and contained zinc, molybdenum, and selenium. Fluorides were also measured and showed significant decreases as compared to slight decreases for copper and sulfur oxides. Sulfur oxides and fluorides were much more subject to seasonal meteorological variations than particulate material constituents. An inverse relationship was observed between suspended particulates and settleable dust, with the former being higher during the windier months and the latter during the more stable inversion months. Concentrations were clearly related to distance from the source, and analysis of statistical distributions showed that both gaseous and particulate matter-related constituents were approximately log-normally distributed.

69744

Itai, Kazuyoshi, Fumio Tsunoda, Shiro Sakurai, and Ekuko Aizawa

STUDIES ON AIR POLLUTION BY FLUORINATED COMPOUNDS (13): ON ATMOSPHERIC CONCENTRATIONS OF FLUORIDES IN VARIOUS PARTS OF THE COUNTRY. (Fukkabutsu ni yoru taiki osen ni kansuru kenkyu (dai-13-ho): Honpo kakuchi ni okeru taikichu fukkabutsu nodo ni tsuite). Text in Japanese. Preprint, Japanese Society of Public Health, Fukushima, p. 416, 1974. (Presented at the Japanese Society of Public Health Annual Meeting, 33rd, Fukushima, Japan, Oct. 16-18, 1974, Paper 546.)

Fluoride concentrations were measured at a total of 52 sites, including residential areas and industrial areas. Near aluminum and steel factories and phosphate fertilizer plants, fluorides were mostly present as water-soluble particles. Near ceramic industries, gaseous fluorides were predominantly present. In metropolitan residential areas, fluorides were generally present in concentrations not exceeding 0.2 micrograms F/cu m. With some pollution sources it becomes necessary to measure water-soluble fluoride particulate concentrations in addition to atmospheric fluoride particulate determination as hydrogen fluoride in order to obtain the precise total fluoride pollution concentrations.

70500

Sapporo District Meteorological Observatory (Japan), Tomakomai Weather Station

THE STATE OF AIR POLLUTION IN TOMAKOMAI. (Tomakomai ni okeru taiki osen no genjo). Text in Japanese. Sapporo Kanki Kishodai Gijutsu Jiho (Sapporo Dist. Meteorol. Observ. Tech. Bull.), no. 82:27-40, March 1974.

The paper and lumber industries in Tomakomai city developed rapidly as a new industrial area after the completion of new harbor in 1963. The air pollution measurements initiated in 1963 are now monitored at the Pollution Control Center established in 1973. The data obtained at 26 measuring points in the city were compiled and analyzed. The yearly average settling particulate was 11.2 tons/k sq m/mo in 1972, and the data compiled since 1963 showed a decreasing trend. Within a 1.5 km radius of Ohji Paper Mill, the sulfur dioxide concentration was as high as 0.5 mg/100 cu cm/day. The relationships between the SO2 concentration and meteorological factors were analyzed. The average fluorine gas concentration was 81.2 micrograms/100 cu cm/mo, however, the concentration reached as high as 150-270 micrograms/100 cu cm/mo in the vicinity of an aluminum refinery and fertilizer plant.

71272

Cross, Frank L., Jr.

FLUORIDE EMISSIONS FROM PHOSPHATE PROCESSING PLANTS. Air Pollution Control Assoc., Pittsburgh, Pa., Southern Section and Technical Council, Control Technol., Agric. Air Pollut., Memphis, Tenn., 1974, p. 159-165. 4 refs. (March 18-19.)

Results from field monitoring activities in the vicinity of a phosphate fertilizer plant are reported. Plant dumps some 2000 tons/day of gypsum waste into a settling pond from which fluorides are released into the atmosphere. Maximum fluoride concentrations of 32,000 micrograms were observed at a distance of 1500 ft from the pond, with the concentration dropping sharply to 3000 micrograms at a distance of 2700 ft. Analyses of citrus leaves within 0.2 mi of the plant revealed levels up to 550 ppm in old leaves and up to 150 ppm in young leaves. Levels of 75 ppm were found in young leaves 0.5 mi from the phosphate plant; this concentration appears useful as an indicator of air pollution capable of reducing citrus yield. Measurements at the surface of the pond demonstrated fluoride emissions of up to 0.16 lb/acre/day. At least 26 lb of fluoride/day were emitted from the 160-acre gypsum pond.

71348

Nakazawa, Y., I. Hirosawa, and M. Maruyama

AIR POLLUTION BY FLUORIDE OF OMACHI DISTRICT, REPORT 2. (Nagano-ken Omachi chiiki no ikeru fukkabutsu ni yoru taiki osen ni tsuite, dai 2-ho). Text in Japanese. Taiki Osen Kenkyu (J. Japan. Soc. Air Pollution), 9(2):542, Nov. 1974. (Presented at the National Air Pollution Research Conference, 15th, Chiba, Japan, Nov. 6-8, 1974, Paper 390.)

The content of fluorine in rainfall and soil was measured in the Omachi area, Nagano Prefecture, where a fluorine pollution source exists. The fluorine concentration in soil increased linearly with the increase in soil particle size. The monthly transition of fluorine level was also studied, and the fluorine level in the winter was higher than that in the summer.

71362

Ando, Asahiro, Kenichiro Terai, and Yoshikazu Nasu

AIR POLLUTION BY FLUORIDE IN TOMAKOMAI, HOKKAIDO PART 2. (Hokkaido Tomakomai chiku ni okeru fukkabutsu osen ni tsuite, dai 2-ho). Text in Japanese. Taiki Osen Kenkyu (J. Japan. Soc. Air Pollution), 9(2):543, Nov. 1974. (Presented at the National Air Pollution Research Conference, 15th, Chiba, Japan, Nov. 6-8, 1974, Paper 391.)

The atmospheric fluorine level in the Tomakomai area was analyzed for contents of gaseous fluoride compounds, and water soluble and water insoluble fluorine particulates using a dry separatory collection technique. The sample was collected at two locations near a fluorine pollution source. The average composition of atmospheric fluorine compounds was 10% gaseous fluoride compounds, 60-70% water soluble, and 20-30% water insoluble fluorine particulates. The average total fluorine concentration in the atmosphere was about 0.8 micrograms/cu m. The conventional fluorine autoanalyzer detected only 10% of total fluorine in air, because the teflon filter inside the analyzer excluded fluorine particulate.

73286

Schaetzle, P.

AIR POLLUTION IN SWITZERLAND. (Die Luftverunreinigung in der Schweiz). Text in German. Gesundheitstech., 8(11):278-281, 1974.

Results of air quality measurements taken in various parts of Switzerland since 1967 are reported. In the Swiss Kanton Basselland the sulfur dioxide concentration of the atmosphere has been measured since 1967 at 15 points according to the method by Liesegang. For the first time since 1967, the atmospheric SO2 pollution dropped significantly in 1973. It rose from 4.2 mg SO2/100 hr in 1967 to 6.3 mg SO2/100 hr in 1972 and dropped to 5.4 mg SO2/100 hr in 1973. The highest monthly average was measured in Muttenz (0.04 mg/cu m in July and 0.18 mg/cu m in January). Dust measurements according to Bergerhoff were likewise taken at 15 measuring points. The lead content was determined in the collected dust. The highest lead concentrations were found near busy streets and in the vicinity of the lead working industry. In 1973 fluoride measurements in the vicinity of brick kilns were taken for the first time. The annual average dust concentrations ranged from 91.7 mg dust/sq m/day to 165.6 mg dust/sq m/day. The dense traffic through Brugg in Switzerland has lead to intolerable carbon monoxide, hydrocarbon, dust, and oxides of nitrogen concentrations. The 12-hour maximum allowable immission value of 9 ppm is exceeded most of the time from 6 am to 10 pm.

73835

Ehime Prefectural Government (Japan), Div. of Life and Environment, Section of Environmental Pollution

ENVIRONMENTAL POLLUTION IN EHIME PREFECTURE IN 1974: PRESENT SITUATION OF AIR POLLUTION. (Ehime no kogai: Taiki osen no genkyo). Text in Japanese. p. 5-40, 1974.

The present status of air pollution in Ehime Prefecture is reviewed. Data on emission quantity (5759.2 cu m/h), maximum one-hour value (0.08-0.45 ppm), and daily average (0.033-0.13 ppm) of sulfur oxides concentrations are compiled and analyzed in reference to regional characteristics. Data on falling particulates (2-23 ton/sq km/mo) and suspended particulate (yearly average 0.02-0.07 mg/cu m) concentrations and hydrogen fluoride concentration (maximum daily average 0.6-7.1 ppb) are also given. Meteorological conditions associated with high oxidant concentration are described. The oxidant

concentration on days when smog forecasts or warnings were issued and diurnal variation in oxidant concentration are given and analyzed in relation to meteorological conditions. The pollution caused by automobile traffic was investigated by measuring carbon monoxide and suspended particulate concentration and analyzed in relation to wind direction, wind velocity, and traffic volume. Regional characteristics of SOx and suspended particulate pollution are also analyzed.

74121

Shizuoka Prefectural Government (Japan)

AIR POLLUTION. (Taiki osen). Text in Japanese. In: Shizuoka Prefectural Environmental White Paper, 1974. p. 15-68, 1975.

Sulfur dioxide concentrations measured at 20 locations in the Fuji area during 1973 ranged from 0.008 ppm at Shibakawacho to 0.047 ppm at Imaizumi. The concentrations measured at 16 locations in the Shizuoka-Shimizu area ranged from 0.013 ppm at Ryunan to 0.034 ppm at Shimizu. The concentrations measured at 12 locations in the Numazu-Mishima area ranged from 0.017 ppm at Tokukura to 0.029 ppm at Nagaizumi. The concentrations measured at eight locations in the Hamamatsu area ranged from 0.019 ppm to 0.51 ppm. The yearly average nitrogen dioxide concentrations measured at 10 locations ranged from 0.018 ppm at Banda and Hakoue to 0.043 ppm at Shizuoka. The yearly average airborne particulate concentrations measured at 33 locations ranged from 0.010 mg/cu m to 0.104 mg/cu m. The average hydrogen fluoride concentrations measured at 10 locations ranged from 0.1 ppb to 0.4 ppb.

76890

Kanagawa Prefectural Environmental Center (Japan)

VARIATION OF ATMOSPHERIC HEAVY METAL CONCENTRATION IN KANAGAWA PREFECTURE. (Kanagawa-ken ni okeru taikichi jukinzoku nodonada no henka). Text in Japanese. Kanagawa-ken Taiki Osen Chosa Kenkyu Hokoku (Tech. Rept. Air Pollution Yokohama-Kawasaki Ind. Area), no. 17:29-48, Feb. 1975.

In Kanagawa Prefecture, the atmospheric concentrations of heavy metals were measured at 15 locations once a month for 3 yr from 1971 to 1973. The data compiled were analyzed in terms of the regional average of the entire period and the average of the entire region on each measurement date. The average atmospheric concentrations (microgram/cu m) of the entire period were 0.005-0.042 for cadmium, 0.20-0.89 for lead, 0.060-0.36 for manganese, 0.016-0.526 for nickel, 2.7-7.7 for iron, 0.001-0.018 for chromium, 0.001-0.017 for cyan, 0.07-0.42 for fluorine, and 141-259 for suspended particulates. The concentrations at ground level and building tops were compared, and correlation coefficients obtained were 0.90 for Cd, 0.77 for Pb, 0.87 for Mn, 0.82 for Ni, 0.73 for Fe, 0.80 for Cr, 0.73 for cyan, 0.66 for F, and 0.81 for suspended particulates. The correlation coefficients between Mn and Fe concentrations were in the range of 0.35-0.95.

77485

Takahashi, R. and T. Watanabe

ON THE RESULT OF MONITORING OF BIFLUORIDE IN KANABARA AREA IN 1972. (Showa 47 nendo Kanbara chiku fussoka suiso kanshi kekka ni tsuite). Text in Japanese. Shizuoka-Ken Kogai Boshi Senta Nenpo (Bull. Environ. Pollut. Contr. Res. Center Shizuoka Prefect.), no. 2:92-95, 1972.

Hydrogen fluoride gas emitted from the Kanbara Plant, Nippon Light Metal Company is damaging agricultural products such as tangerines. Monitoring of the HF concentration in the atmosphere was conducted at nine locations, and accumulated HF was measured at 38 locations. The rain water pH soluble fluorine, and dust were measured at five locations. The accumulation of fluorine in tangerine leaves was measured at 14 locations. Wind direction and velocity were measured at two spots. During 1972, HF pollution decreased by 22%, and the fluorine concentration in tangerine leaves decreased by about 14%. More than 1.5 km from the pollution source the HF concentration in the area was 5 micrograms/100 sq cm/day. The fluorine content of tangerine leaves (new leaves, collected in October) was approximately 100 ppm. The correlation between the amount of fluorine contained in tangerine leaves collected in October and the results of HF measurements indicated that the fluorine in the leaves was mostly due to HF in the atmosphere. Although fluorine ion dissolved in rain water, it did not affect the pH. About thirteen times as much fluorine ion was detected at areas near the pollution source as compared to those more distant from the source.

77512

Hosokawa, Y., S. Izumi, M. Chinda, T. Seki, T. Narita, and H. Ohno

ON THE FLUORIDE CONTAMINATION AT HACHINOHE AREA. (Hachinohe chiku ni okeru fukkabutsu osen ni tsuite). Text in Japanese. Aomori-ken Kogai Senta Shoho (Rept. Environ. Pollut. Control Cent., Aomori Prefect.), no. 1:60-64, Feb. 1975.

Toyo number 5B filter papers treated with 30% sodium carbonate solution were used to collect fluorides in the air at 22 locations throughout the city and number 51A papers treated with 1% Na2CO3 were fixed in a multi-stage low-volume sampler to collect fluorides in the flue gas from polluting sources. The average fluoride concentration in August 1974 ranged from non-detectable at the Musu primary school to 60 micro g/100 sq cm/month at Miyazaki-taku. The average concentration in September ranged from non-detectable at 6 locations to 183 micro g/100 sq cm/month at Miyazaki-taku, that in October from non-detectable at 5 locations to 98 micro g/100 sq cm/month at the second fish market and that in November from non-detectable at 6 locations to 1974 micro g/100 sq cm/month at the Second Fish Market. The fluoride concentration at the polluting sources ranged from non-detectable in the flue gas of the electric furnace at Hachinohe Steel Works to 5.9 mg/N cu m in the flue gas of an electric furnace at the Taiheyo Metal Company.

78193

Tochigi Research Inst. for Environmental Pollution, Dept. of Air Quality and Noise

SURVEY RESULTS FOR ATMOSPHERIC POLLUTANTS. (Taikichi ni okeru osen busshitsu no chosa kekka ni tsuite). Text in Japanese. Tochigi-ken Kogai Kenkyusho Nenpo, (Annu. Rep. Tochigi Prefect. Res. Inst. Environ. Pollut., no. 1:78-90, Jan. 1975.

Atmospheric pollutants (sulfur oxides; automotive emissions; hydrogen fluoride) were measured during 1971-1973, at various locations in Tochigi Prefecture, Japan. Concentrations of sulfur oxides were highest (0.033-0.087 ppm, 24-hr average values) in Ashio City, where copper mines are located. Elsewhere in the prefecture, SOx concentrations ranged from 0.002-0.014 ppm, at 20 locations. Automotive emissions (carbon monoxide, nitrogen oxides) were measured at 11 major intersections in the prefecture. From 1971 to 1973, some decrease was seen in the 8-hr average values of CO (4.4-10.7 ppm, 1971; 2.3-7.4 ppm, 1973). Average 24-hr values of nitrogen dioxide increased yearly from 1971 to 1973 (0.025-0.040 ppm, 1971; 0.033-0.076 ppm, 1973). Average 24-hr values

of nitrogen monoxide ranged from 0.040-0.138 ppm in 1973. Traffic volume concentrations of airborne dust, lead, vanadium, and aldehyde were measured at 6 urban intersections in 1973. Types of vehicles were not differentiated. For an 8-hr sampling time, the number of vehicles ranged from 1154 to 3166. Ranges of pollutant concentrations were: dust, 0.26-0.96 mg/cu m; lead, 0.76-1.59 micrograms/cu m; vanadium, 0.09-0.14 micrograms/cu m; aldehyde, 0.01-0.05 ppm. In 1973, at 6 locations, 24-hr average values of HF ranged from 0.22-2.73 ppb, with measured values ranging from 0.14-7.15 ppb. There was no clear correlation between HF and plant damage.

78442

Risto Ajo

THE MEASUREMENT OF AIR POLLUTION. (Ilman saasteanalyysi- mittauksia). Text in Finnish. Kemia-Kemi, no. 6:340-341, 1974. 2 refs.

In those areas where industrial and urban development is greatest, pollution is usually heaviest. In West Germany the quantities of the following impurities emitted into the air in 1969 were as follows: carbon monoxide, 8/Mton; dusts, 4 Mton; Sulfur dioxide, 4 Mton; nitrogen oxides, 2 Mton; hydrocarbons, 2 Mton. There were 2 Mton of fluorides, hydrogen chloride, and strong-smelling substances combined. Fifty-six percent of this was caused by traffic, 18% by energy production, 17% by industry and 9% by households. Measurement stations are generally situated near large industrial and urban centers. When the information from a large area is collected for further analysis there are several advantages. Planning of new industrial sites and traffic routes is improved, smog warnings can be issued when critical levels are reached and polluting industries can be located. The state of Baden-Wurttenberg in West Germany is installing a network of measuring stations. Siemens, Inc. is supplying the analyzers, information transfer machinery and process computers. The industrial and urban density is light in Finland and a network of this kind is not yet a timely issue.

78954

Hokkaido Prefectural Government Office, Dept. of Life Environment

PRESENT SITUATION OF AIR POLLUTION IN HOKKAIDO. (Hokkaido no Taiki osen jokyo). Text in Japanese. 548p., Jan. 1975.

Results of air pollution measurements in 1973 at more than 20 locations in Hokkaido are tabulated. Sulfur dioxide and sulfur oxides were analyzed by conductivity and lead dioxide methods, respectively; airborne aparticulates by a light scattering method; nitrogen oxides and oxidants by a spectrophotometric method, hydrogen fluoride by specific ion electrode, and dust was by deposit gauge. The average SO2 concentrations ranged from 0.008 ppm at Utonai to 0.025 ppm at Shinnittetsu Gymnasium at Muroran. The average airborne particulates concentrations ranged from 0.02 mg/cu m at 9 locations (out of 14) to 0.08 mg/cu m at Tokura store at Obihiro. The average NOx concentrations ranged from 0.017 ppm at Akino, a semi-industrial area, to 0.11 ppm at Living Yasumoto, a commercial area. The average oxidants and HF concentrations at Akino were 0.028 ppm and 0.1 ppb, respectively. The highest average dust concentration was 52.3 t/sq km/mo at Shinittetsu Gymnasium. The highest average SOx concentration was 0.85 SO3 mg/day/100 sq cm at Yusaicho in Muroran city.

79343

Kumamoto Prefectural Government (Japan)

PRESENT SITUATION AND CONTROL OF AIR POLLUTION. (Taiki osen no genjo to taisaku). Text in Japanese. In: Environmental White Paper in 1974, p. 11-32, June 1975.

In Kumamoto prefecture, sulfur oxides and suspended particulates are two major air pollutants, and pollution problems by hydrogen fluoride and hydrogen chloride are observed locally. The SOx concentration and suspended particulates measured since 1964 showed a generally decreasing trend after 1970. Data on SOx concentration measured in Arao, Yashiro, Minamata, Kumamoto and Uto cities are compiled and analyzed. The yearly average SOx concentrations(ppm) for 1972 and 1973 were 0.020-0.027 in Arao, 0.017-0.019 in Yashiro, 0.014-0.021 in Minamata and 0.021-0.026 in Kumamoto. Suspended particulate concentrations (yearly average of 1972 and 1973) were 0.025-0.059 in Arao, 0.025-0.056 in Kumamoto, 0.046-0.081 in Yashiro and 0.047-0.081 in Minamata. Amounts of sedimented dust (ton/sq km/month) measured in 1973 were 5.55 in Arao, 4.8 in Kumamoto, 5.62 in Yashiro and 5.84 in Minamata. In Arao city, the HF concentration was measured by the ion electrode method, and the yearly average HF concentration was 0.18-0.24 ppb.

83399

Fukuoka Prefectural Environmental Pollution Center

INVESTIGATIONS OF AIR POLLUTION. (Taiki Osen Kankei). Text in Japanese. In: Annual Report of Fukuoka Environmental Research Center (1973), p. 30-34, 1975.

The following studies were made in 1973: the effect of combined pollutants on humans; gaseous air pollution in Fukuoka; the distribution of air pollutants; air pollution of underground arcades; air pollution in Karita, Ikuhashi, and Mizumaki; dust pollution in the Tagawa area and in Omuta city; the effects of fluorine in the Omuta and Orano area; and damage to vegetation by fluorine. Fukuoka Prefecture had higher concentrations of sulfur oxides, nitric oxide, nitrogen dioxide, and dust compared to the national average, but lower cadmium, manganese, lead, and iron. The investigation of dust pollution in the Tagawa area was conducted to prove that the source of environmental pollution in this area is a cement plant. The investigation found large amounts of heavy metals such as cadmium, copper, zinc, and manganese in airborne dust and dust deposits in the Tagawa area.

84625

Ebisawa, E.

SUMMARY OF AIR POLLUTION SURVEY. (Taiki osen chosa no gaiyo). Text in Japanese. Ibaraki-ken Kogai Gijutsu Senta Nenpo (Annu. Rept. Environ. Pollut. Res. Center, Ibaraki Pref.), no. 7:17-19, Oct. 1975.

An air pollution survey in Ibaraki Prefecture is summarized. There were 22 monitoring stations for sulfur dioxide and airborne particulates, and 16 stations for nitrogen oxides and oxidant measurements. Photochemical smog emergency warnings were issued 34 times, while forecasts of photochemical smog emergency were issued 71 times. Seventeen complaints claiming oxidant damage were filed. The damage to morning glory by photochemical smogs and the damage to plant leaves by fluorides were investigated. Visible damage to plant leaves was observed at some places near an aluminum treatment factory, and 95 ppm to 48 ppm fluoride was detected. Damage to the morning glory was observed at Kashima City and Mito City

E. ATMOSPHERIC INTERACTION

02325

K. D. Hage, N. E. Bowne, and G. R. Hilst.

PRELIMINARY ESTIMATES OF ENVIRONMENTAL EXPOSURE FOR FUEL AND EXHAUST PRODUCTS. VOLUME I. Travelers Research Center, Inc., Hartford, Conn. (Rept. CR-61056). Jan. 1965. 158 pp. NASA: CR-61056

A preliminary mathematical model that attempts to describe the transport and growth of a gas or vapor cloud released from a quasi-instantaneous volume source in low-level shearing wind flow was formulated and programmed for use on a digital computer. Computations of smoothed peak concentrations and total dosages were performed for plane polar grid points within a 90 degree sector at ground level from the source to distances of about 15 km. The computations were performed for specified initial conditions believed to be representative of test firing exhaust releases of hydrogen fluoride and pipeline spill releases of liquid fluorine at Marshall Space Flight Center, Huntsville, Alabama. An experimental program has been presented for MSEC with three alternatives of complexity and cost which lead to different solutions for the problem of atmospheric diffusion in the Huntsville area. The basic experimental design is the same for all programs, i.e., use of an aerosol tracer to measure diffusion of material and resultant surface concentrations. As the complexity and costs increase so does the understanding of the diffusion processes. The design anticipates a curvature in the trajectory of material released from the static test area in a wind flow that would result in material reaching Huntsville. A thorough mathematical analysis of the statistical diffusion model was prepared to ensure the sampling density would be satisfactory but not excessive. Provisions were made for determining peak concentration.

04987

M. D. Thomas

THE PRESENT STATUS OF THE DEVELOPMENT OF INSTRUMENTATION FOR THE STUDY OF AIR POLLUTION. Proc. Natl. Air Pollution Symp., 2nd, Pasadena, Calif., 1952. pp. 16-23.

Numerous instruments are discussed for the study of sulfur dioxide, hydrogen sulfide, mercaptans, other sulfur- containing gases, hydrogen fluoride, smog gases, particulate matter, wind, and other meteorological parameters.

05054

R. K. Siler

METEROLOGICAL CONSIDERATIONS IN THE HANDLING OF A MIXTURE OF LIQUID FLUORINE AND LIQUID OXYGEN. Weather Bureau, Washington, D. C., Spaceflight Meteorology Group. Oct. 15, 1964. 47 pp.

Fluorine is a highly toxic and corrosive gas, the safe handling of which requires the utmost care. HF is considerably less toxic than F, but is very corrosive. Optimum weather conditions for the diffusion of FLOX are difficult to define. If it is assumed that the cloud will conform to the characteristics of a ground level release, then the following weather conditions would provide optimum release conditions: (1) Unstable atmosphere; (2) Variable winds blowing away from populated areas and preferably offshore; (3) Rain. If a catastrophic spill occurs, it is likely that the resulting cloud, or fireball, would assume the characteristics of an elevated, instantaneous release. This would occur because the high temperatures of reaction with H2 and the buoyancy of HF would displace the cloud upwards at a rapid rate, penetrating and temporarily destroying any low-level inversion. Under these circumstances optimum weather conditions would be: (1) Stability in the lower levels; (2) Offshore winds; (3) High moisture content from surface to pollutant level. In the mean these conditions are more likely during the nighttime hours in the months of December through March. From April through November low-level winds are predominantly onshore and during the summer months atmospheric instability is strongest and is of longest duration. The climatology presented here suggests a location for FLOX storage facilities that is isolated from populated areas, orchards or costly structures, particularly in the northwest and southeast quadrants. In general, these are the directions of the prevailing winds and the strongest winds. Fog and low ceilings occur most frequently with winds from the northwest quadrant.

14897

Centre Departemental d'Etude des Pollutions Atmospheriques, Paris, Section Sante et Meteo.

A DAY OF POLLUTION IN THE LACQ REGION. (Journee de pollutin vecue dans la region de Lacq). Text in French. Pollut. Atmos. (Paris), 11(Special):36-40, Feb. 1969.

Observations and measurements of pollution are reported for the period from Oct. 4 to 5, 1968, in the 15 km-wide valley of the Gave de Pau. On the night of Oct. 4, a 4-day old descending inversion reached an 11-degree amplitude with a 700-m thickness. Early morning pollution was near zero, but as the fog cleared and wind conditions of less than 1 knot prevailed, pollution indices rose greatly. Later in the day the wind rose, and in the absence of any inversion, pollution dropped by a factor of 10. A gas desulfurization plant in the valley emits 500 to 1000 tons of sulfur dioxide daily. Measurements made by absorption of acid gases in glycerinated 0.5 NaOH, in hydrogen peroxide solution, or in glycerinated zinc acetate gave qualitatively similar results. Emissions were from a 104-m high chimney, but maximum ground level pollution was found 5 km from the chimney, a distance about 40 times the theoretical chimney height, i.e., the plume height above the chimney. Another source of pollution in the valley is an aluminum extraction plant which employs the Soderberg process and emits 150 kg per day of fluoride ions. Measurement by exposure of lime-impregnated papers, with colorimetric estimating techniques, correlated in 70% of the cases with direct absorption on fiberglass, and was reproducible to better than 10%. Decrease of pollution with distance was found to be exponential, with the worst pollution occurring within 2 km of the plant.

29023

Lovelock, J. E.

ATMOSPHERIC FLUORINE COMPOUNDS AS INDICATORS OF AIR MOVEMENTS. Nature (London), 230(5293):379, April 9, 1971. 2 refs.

Preliminary measurements are reported for atmospheric concentration of sulfur hexafluoride and trichlorofluormethane and atmospheric turbidity in southwest Ireland during July and August 1970. The contaminants were measured with a gas chromatograph with an electron capture detector, the turbidity with a sun photometer. High concentrations of CCl3F and SF6 and appreciably increased turbidity are noted to be associated with easterly winds from continental Europe. These observations lend support to the proposal that CCl3F and SF6 can be used as indicators of air masses recently polluted by industrial pollutants.

29315

Cooke, N. E.

AIR SURVEYS LINKED WITH MATHEMATICAL MODEL TO PROTECT ENVIRONMENT. Water Pollution Control (Toronto), 109(5):59-61, May 1971. 4 refs.

Data from long-term air measurements were used to develop atmospheric dispersion equations describing ground-level concentrations of fluorides from the gypsum ponds and the diammonium phosphate stack of fertilizer complex and fluoride plus sulfur dioxide concentrations from a neighboring power plant stack. With the equations it was possible to simulate mathematically any combination of circumstances affecting the fertilizer plant emissions and to determine appropriate pollution control measures. On the basis of the study, it was decided to install a venturi scrubber in the diammonium phosphate stack and to create a buffer zone around the gypsum plant.

29774

Haagen-Smit, A. J. and Lowell G. Wayne

ATMOSPHERIC REACTIONS AND SCAVENGING PROCESSES. In: Air Pollution Arthur C. Stern (ed.), Vol. 1, 2nd ed., New York, Academic Press, 1968, Chapt. 6, p. 149-186. 77 refs.

Atmospheric influences can change air pollutants. Through turbulence and diffusion, substances released at ground level will eventually be exposed to conditions in the upper atmosphere and become accessible to high energy photons which break up even the most stable molecules. Ozone reacts with nitrogen to form several oxides. The energy requirements, light source, reactions, free radical formation, and chain reactions in photochemical and photosensitized reactions are discussed. Heterogeneous reactions may also take place on the surfaces of various solid and liquid particles. Again, light can play an important role. Mathematical simulations of atmospheric dispersion of stack gases can be used to predict atmospheric concentrations. Inorganic pollutants include sulfur oxides and nitrogen oxides. Organic pollutants are formed in photochemical smog. The process and symptoms of photochemical smog are given including data for downtown Los Angeles. Spectrograms have been used to determine the chemical nature of smog. Eye irritation is a function of hydrocarbons and nitrogen oxides. Photochemical reactions can also cause rubber cracking. The chain reactions in photochemical smog are quite complex. Suggested photooxidation mechanisms involving branching chains and the reaction of oxygen atoms with olefins are also given. Scavenging foreign material from the atmosphere consists of deposition and conversion to normal atmospheric constituents. Most of the sulfur contaminants are emitted in the form of gaseous sulfur dioxide, some of which oxidizes to sulfur trioxide which then reacts with water vapor to form sulfuric acid. Hydrogen fluoride, hydrogen sulfide, ammonia, carbon dioxide, carbon monoxide, nitrogen oxide, fly ash, and particulates are also pollutants. The washout mechanism is effective in removing some particles.

29910

Konovalov, G. S. and T. Kh. Kolesnikova

TRACE ELEMENTS IN ATMOSPHERIC PRECIPITATION AROUND THE OTKAZNOE RESERVOIR. (Mikroelementy v atmosfernykh osakdakh rayona Otkaznenskogo vodokhranilishcha). Text in Russian. Gidrokhim. Materialy, vol. 49:74-79, 1969. 15 refs.

The amounts of 17 trace elements introduced into Otkaznoe water reservoir with atmospheric precipitation were analyzed in a one year study. Boron, fluorine, bromine, and iodine in atmospheric precipitation were determined by chemical analysis; those of vanadium, manganese, cobalt, nickel, copper, molybdenum, silver, tin, lead, iron, aluminum, bismuth, and titanium were determined spectroscopically. The elements Co, Mo, Ag, Sn, Pb, and Bi were not found in atmospheric precipitation. The content of other elements was higher in comparison with other areas. This is explained as depending on the character of climatic conditions of the area, i.e., dry and windy climate and poor coverage by plants, which cause increased dustiness of the atmosphere.

30126

Wilkniss, P. E. and D. J. Bressan

CHEMICAL PROCESSES AT THE AIR-SEA INTERFACE: THE BEHAVIOR OF FLUORINE. J. Geophys. Res., 76(3):736-741, Jan. 20, 1971. 14 refs.

Ion fractionation between fluorine and chlorine at the air-sea interface was investigated. Radiochemical experiments showed a decrease in the F/Cl ratio for laboratory aerosols produced from sea water. Marine aerosols showed an increase in the F/Cl ratio with a possible contribution from airborne dust contamination. Jet drops in the laboratory and naturally occurring marine jet drops showed little to no change. Radiochemical tracers also showed that drying of sea water droplets sometimes increased the F/Cl ratio of the salt residue, whereas acidification of the sea water always caused the residue to have a decreased ratio. The observed complex chemical behavior of fluoride in air-sea interactions suggests the necessity of taking new approaches in the laboratory and in field experiments. (Author abstract modified)

33092

Hollinden, A. B.

METEOROLOGICAL SITING FOR TOXIC FUEL TESTING. Preprint, American Meteorological Society, Boston, Mass., and American Inst. of Aeronautics and Astronautics, New York, p. 458-461, 1970. (Presented at the National Conference on Aerospace Meteorology, 4th, Las Vegas, Nev., May 4-7, 1970.)

Different sites in the Gypsum Canyon, Calif., were considered as storing and testing grounds for such toxic propellants as nitrogen dioxide, uns-dimethylhydrazine, hydrazine, pentaborane, and fluorine. The distribution downward of the toxic material depends on the mean wind flow pattern and the diffusive action caused by atmospheric turbulence. Tests were carried out to obtain details of flow in the canyon. Gypsum Canyon is a north-south canyon located in a desert region. Prevailing synoptic situation throughout the year involved

weak pressure gradients, and local circulation predominated. On a typical sunny day the wind in the main canyon blew up the canyon at speeds from 3 knots at 9:30 am to 6-7 knots at 12:30 pm, at which time it became variable. A sudden surge of down-canyon wind then occurred and the winds gradually weakened but remained southerly 6-7 knots until 4 or 5 pm. This wind reversal had little or no effect on the circulations in the side canyons. Five of the sites considered were located, respectively, on the small center ridge, the north slope of side-valley, the east side of side-valley entrance, a side-canyon, and a sharp ridge 75 feet higher than the main canyon floor. Classifications of each with respect to meteorological conditions are included.

33579

Kobayashi, Masatoshi

ENVIRONMENTAL POLLUTION AND THE USE OF RI (RADIOACTIVE ISOTOPE). (Kankyo osen to RI riyo no genjo). Text in Japanese. Genshiroyoku Kogyo, 17(8):5-8, Aug. 1971. 6 refs.

Tracer studies of gas dispersion patterns and chemical reactions using isotope ratios are discussed. Isotope ratios in sulfur are extremely different according to the conditions of accumulation and compaction of natural resources. Using this fact, a method of tracing dispersions of flue gases by identification of the S isotope ratio which is different from S in the air was developed. Sampling of sulfur dioxide is taken by a glass fiber preliminary filter and a cellulose filter with SO2 absorbent. The preliminary filter collects soot and SO3, and the second filter recovers SO2. After a chemical treatment, a quantitative analyzer measures the S isotope ratio; SF(6), emitted artificially from the flue with SO2, is measured by gas chromatography. Both data are compared, and the dispersion pattern and SO2 oxidation and reduction are determined. The method of tracing in a more difficult, complex environment is also given. Other radiation applied apparatus such as Sr (90) ozone counter and an Egg shell thickness gage are described. Application of radio-release and chemical substitution using kryptonate, developed by Schleck, and quantitative determinations of SO2 gas, fluoride, oxygen residue, chromium oxide ion, and vanadium hydroxide by various isotopes are briefly disscussed.

37013

Ivos, J., Hania Ciszek, A. Rezek, and Lj. Marjanovic

FLUORINE WASTE GASES IN THE SURROUNDING ATMOSPHERE OF YUGOSLAV FACTORIES. (Otpadni plinovi fluora u okolisnoj atmosferi nasih tvornica). Text in Serbo-Croatian. Vet. Arh., 40(3/4):61-77, 1970. 20 refs.

The transport of fluorines in Yugoslav areas threatened with outbreaks of fluorosis and the concentrations of fluorine in the electrolysis rooms and the atmospheres of aluminum factories were investigated with respect to direction, range, and speed of dispersion and relation to the hydrometeorologic characteristics of the area. In the electrolysis rooms, monitored in three factories, average annual fluoride concentrations were 4.6, 5.6, and 3.6 mg/cu m. The concentration in the surrounding atmosphere, determined by analysis of the precipitation, was 0.4 mg/l annually. Fluorides moved in the direction of the prevailing winds to a defined distance and then decreased again. The annual average concentrations for all six measurement locations ranged from 1.04 to 0.14 mg/l.

37037

Hendrickson, E. R.

DISPERSION AND EFFECTS OF AIR BORNE FLUORIDES IN CENTRAL FLORIDA. J. Air Pollution Control Assoc., 11(5):220-225, 232. May 1961. 14 refs. (Presented at the Air Pollution Control Association, Annual Meeting, 53rd, Cincinnati, Ohio, May 22-26, 1960.)

Citrus groves, winter truck crops, and commercial gladioli in a 100-sq-mile area of central Florida all show evidence of damage by airborne gaseous fluorides. Sources of the fluorides are phosphate rock drying and grinding plants, superphosphate and elemental phosphorus plants, and a defluornating plant. The dispersion of the gaseous fluorides is tracked by a network of static sampling stations using filter papers treated with calcium formate solution (sulfur dioxide is also measured, by the lead peroxide candle method). During the sampling period, records are also obtained of wind direction and velocity and vertical temperatures in the area. When analysis is complete, concentrations are plotted on maps for each month at each sampling station. From this information isopleths are drawn in the light of wind roses for that particular month. With this technique, it is possible to determine the extent of pollution from several sources, to compare one area with another, and to evaluate monthly changes in exposure at single stations.

37639

Ivos, J., Hania Ciszek, A. Rezek, and Lj. Marjanovic

FLUORINE WASTE GASES IN THE SURROUNDING ATMOSPHERE OF YUGOSLAV FACTORIES. (Otpadni plinovi fluora u okolisnoj atmosferi nasih tvornica). Text in Serbo-Croatian. Vet. Arh., 40(3-4):61-77, 1970. 20 refs.

The dispersion of fluorides was investigated in three areas of Yugoslavia jeopardized by fluorosis: Kidricevo, Lozovac, and Razine. Fluorides were measured in both aluminum electrolysis rooms and the open atmosphere to determine the direction and extent of their dispersion. The annual average levels in the electrolysis rooms were 4.6 mg/cu m at Kidricevo; 5.6 mg/cu m at Lozovac; and 3.6 mg/cu m at Razine. In the Ptuj field (Kidricevo), the average annual amount of fluoride in precipitation was 0.4 mg/l at six locations representing various directions and distances from the source of contamination. The annual average amount of fluorides for all six locations was 1.04-0.14 mg/l. The fluoride-containing waste gases moved in the direction of prevailing winds to a definite distance, after which the concentrations decreased.

40271

Bartels, Otto G.

AN ESTIMATE OF VOLCANIC CONTRIBUTIONS TO THE ATMOSPHERE AND VOLCANIC GASES AND SUBLIMATES AS THE SOURCE OF THE RADIOISOTOPES BE(10), S(35), P(32) AND NA(22). Health Phys., 22(4):387-392, April 1972. 30 refs.

Utilizing new data on the presence of a sulfate aerosol layer in the stratosphere, an analysis is made of the source of excess sulfate in precipitation. Data are presented against the hypothesis of appreciable escape to the atmosphere of hydrogen sulfide produced on the continental shelves. Calculated volcanic contributions to the atmosphere in metric tons/yr are chlorine-7.6 million, sulfur-17 million, fluorine-7.3 million, boron-73,000, sodium-6 million, potassium-2.3 million, and calcium-7.2 million. The calculations support Conway s hypothesis of volcanic water and the volcanic chloride origin of the ocean. The points of weakness in the spallation hypothesis of atmospheric radioisotopes are presented. A table

with the probable nuclear particle abundance at 16 km altitude is given. Calculations are made of the relative concentrations of boron, chlorine, sulfur, and fluorine in the upper atmosphere. The results almost parallel the abundance values in igneous rocks. Data on the probable altitudes where the nuclear ractions occur are presented including a new source for the sodium lines in the upper atmosphere air glow. (Author abstract)

43424

Wilkniss, Peter E. and David J. Bressan

GEOCHEMICAL ASPECTS OF INORGANIC AEROSOLS NEAR THE OCEAN-ATMOSPHERE INTERFACE. Am. Chem. Soc., Div. Water, Air Waste Chem. Gen. Paper, 11(2):156-158, Sept. 1971. 14 refs.

Aerosol samples collected over the oceans near the air-sea interface were analyzed. Efforts were directed toward the determination of metals such as sodium, magnesium, aluminum, titanium, vanadium, manganese, scandium, iron, cobalt, antimony, cerium, and europium by neutron activation analysis, and of fluorine and chlorine by photon activation. Atomic absorption spectroscopy was used to determine sodium, potassium, iron, and manganese. The fluoride ion-specific electrode was used to determine fluoride in seawater, sea spray, and rainwater. Comparison of the elemental ratios for Ce/Fe, Sc/Fe, Co/Fe, and Eu/Fe with those of other investigators showed good agreement. Comparison of results obtained from the Indian Ocean for Al/Fe and Mn/Fe with the present results for same elemental ratios over the Atlantic agree satisfactorily. Comparison of these results with average elemental ratios found in seawater and in crustal rocks shows that the source of the trace metals is the continents rather than the ocean. The elemental ratios for Sc/F, Fe/F, Na/F, and Ti/F differ by several orders of magnitude for seawater and average crustal rocks. These ratios were determined in Atlantic aerosols and indicate that the continents are the source of these trace metals. Fluoride concentrations are an excellent indicator of a marine aerosol. The results for inland rain compare well with the same elemental ratios determined over land in aerosols near the east coast of the U. S. In coastal areas aerosols rapidly change to continental characteristics.

43855

Malte, P. C. and J. A. Nicholls

INFRARED DETECTION OF HF TRACER GAS IN INERT AND COMBUSTING FLOWS. Preprint, American Inst. of Aeronautics and Astronautics, New York, 17p., 1972. 26 refs. (Presented at the American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 10th, San Diego, Calif., Jan. 17-19, 1972, Paper 72-70.)

A noninterfering diagnostic technique that employs monomeric hydrogen fluoride as a passive tracer gas was developed. Infrared absorption by HF is used to infer turbulent mixing rates in inert and combusting flows. Data are presented on the turbulent diffusion of HF seeded streams of air, heated air, hydrogen, and carbon dioxide into an outer coaxial air stream. Combustion of acetylene and air in a free jet configuration was also investigated with the HF tracer. In most of these flow situations, the HF exhibited apparent rotational nonequilibrium. Development of the experimental technique and methods for data acquisition and analysis are discussed. (Author abstract modified)

44030

Constance, John D.

SIMPLIFIED METHOD FOR DETERMINING INHALABLE CONTAMINANTS. Pollut. Eng., 4(4)30-31, July 1972.

An easy method is presented for estimating transient atmospheric contaminant concentration in in-plant atmospheres and processing enclosures. In an actual in-plant operation, the number of air changes needed to render an enclosure suitable for entry by plant personnel may be estimated using this method and graph. Threshold limit values for a number of vapors are listed, and two examples of the method are included. One pertains to sulfuryl fluoride and the other to methyl chloride concentrations. (Author abstract modified)

44277

Auermann, E., W. Fojt, and J. Janetzky

COMPARISON OF MEASURED AND CALCULATED FLUORINE EMISSION CONCENTRATIONS. (Vergleich gemessener und berechneter Fluor-Immissionswerte). Text in German. Z. Ges. Hyg. Ihre Grenzgebiete (Berlin), 18(6):414-418, June 1972. 5 refs.

The fluorine emissions of a source were measured at the stack and six measuring stations erected in all directions at distances of 200 to 650 m. For the emission measurements, samples were taken with a platinum probe. For the determination of the fluorine the method by Megregian was slightly modified and applied. The measuring accuracy was + or - 15%. For determination of the emission concentrations, the air samples were drawn with a speed of 6 l/min through a heavily diluted sodium hydroxide solution (n/500). The concentration was determined by colorimetry. The temperatures at the measuring sites were between 6 and 8 C and 4 and 5 C. The winds from southwest to west had an average velocity of 4 m/sec 2 m above the ground. With the aid of the formulas by Bosanquet and Pearson, the fluorine concentrations were calculated and compared with the measured results. A good agreement between the two results was achieved. The background concentration was between 2 and 9 micrograms/cu m. Maximum concentrations (4.0, 9.0 and 5.3 micrograms/cu m) were measured in a distance of 290 m at an average wind speed of 6 m/sec. The emission concentrations were 45, 62, and 103 mg/cu m.

49185

Sueda, Shintaro, Kenichi Shimohara, Yukio Eguchi, Nobuyasu Shigemori, and Takashi Akiyama

FLUORIDE AND SULFATE CONCENTRATION IN THE ATMOSPHERE OF KITA-KYUSHU CITY. (Kita-Kyushu shi ni okeru talki-chu fusso oyobi ryusankon no bunpu). Text in Japanese. Japan Society of Air Pollution, Proc. Symp. Japan Soc. Air Pollut., 13th, 1972, p. 187. (Nov. 7-9, Paper 142.)

Thirty-two monitoring stations were installed in Kita-Kyushu in June 1971, and the measurements of fluorides and sulfates, and the distribution changes were observed. Settling particles and rain water collected in deposit gauges were filtered, and the solution was distilled. The lanthanum-alizarin-complexion method was used for fluorides and nephelometry was used for sulfate determinations. Sulfur dioxide measurements were taken by the lead dioxide method. The sulfate distribution was high along the Dokai Bay and agreed with the distribution pattern of SO2 gas. Fluorides showed a similar distribution pattern, but the concentration was especially high in the Kokura industrial area. In northern Moji, sulfate was low but fluoride concentration was high. Sulfate concentration was high in June and February and low in July, August, and Oct. The SO2 fluctuations were similar. Fluoride count was low only in Oct.

49433

Hirosawa, Iichiro, Yuhei Nakazawa, and Masato Maruyama

AIR POLLUTION BY FLUORIDE IN THE OMACHI DISTRICT. (Nagano-ken Omachi chiku ni okeru fukkabutsu ni yoru taiki osen ni tsuite). Text in Japanese. Japan Society of Air Pollution, Proc. Symp. Japan Soc. Air Pollut., 13th 1972, p. 188. (Nov. 7-9, Paper 143.)

Fluoride near an aluminum refining factory was measured by the LTP method, and the fluoride accumulation in red pine needles was used as an index for pollution. The monitoring stations were installed at 15 locations covering 5 km east to west and 10 km south to north surrounding the aluminum plant. The fluoride accumulation was checked monthly from May 1971 to April 1972. One-year-old red pine needles were collected, and F content was determined by the photometric method. In the north-south directions, approximately 750 micrograms/100 sq m/mo was accumulated at 400 m from the plant and 250 micrograms at 800 m. The accumulations were only 20-30 micrograms in the east-west directions. In the south, seasonal fluctuations were great; they were 80-100 micrograms/mo in the summer, but the amount was four or five times greater in the winter. Near the plant, the F accumulation in pine needles was 200-300 ppm. In the leeward side, even at distances of 15,000 to 20,000 m, 20 to 30 ppm F were found. In this area, the wind was predominantly northerly and pollution extended to the south. There was a high correlation (0.977) between yearly accumulation of F and the F content in pine needles.

59075

Kuelske, S.

TESTING AN AREA SOURCE MODEL THROUGH APPLICATION TO AN ISOLATED AREA SOURCE AND SIMULTANEOUS CONCENTRATION MEASUREMENTS. (Ueberpruefung eines Vielquellenmodells durch Anwendung auf einen isolierten Flaechenemittenten und parallele Immissionsmessungen). Text in German. VDI (Ver. Deut. Ingr.) Ber., no. 200:189-198, 1973. 6 refs.

A multi-source model was used to analyze the fluoride concentration in the vicinity of an aluminum plant. The set of emitters consisted of two furnace halls, each 560 m long and 16 m high, and a chimney 130 m high. Concentrations were calculated for selected meteorological conditions and for a 5 by 5 sq km grid with a spacing of 200 m. The calculated results were compared with measured concentrations. Using mobile measuring devices, measurements were taken in the plume from the set of emitters. Up to 20 instrument mobile stations were used simultaneously. Comparisons between calculated and measured results were obtained at 30-minute intervals and for 86 sets of conditions. The results are explained and interpreted.

59234

Jansen, P., S. Jordan, and W. Schikarski

COMPARATIVE MODEL THEORY OF THE ATMOSPHERIC POLLUTANT LOAD CAUSED BY POWER PLANTS. (Vergleichende Modelltheorie der atmosphaerischen Schadstoffbelastungen durch Kraftwerke). Text in German. Inst. Natl. Rech. Chim. Appl., Dixieme Colloq. Atmos. Polluees, Proc., Paris, France, 1972, 10p. 32 refs. (May 3-5.)

A model theory of the air pollutant loads caused by conventional and nuclear power plants, and future development of the pollutant loads on the basis of the expected energy production and of the maximum allowable ground level concentrations is presented. The pollutants concerned are sulfur dioxide, nitrogen oxides, dust, and fluorine compounds as well as xenon-113 and krypton-85. The specific SO2, dust, nitrogen oxide, and fluorine emissions from coal are 6.0-7.7; 1.4-2.7; 1.4-4.6, and 0.05-0.11 g/per kWh. The corresponding values for oil are 7.4 g of SO2, 0.7 g of dust, 1.5-3.4 g of nitrogen oxides, and 0.004 g of fluorine per kWh. Natural gas produces 0.002 g of SO2, and 0.7-3.1 g of nitrogen oxides per kWh. The hold time of air pollutants in the atmosphere is dependent of their concentrations, high concentrations corresponding to short decay times. The hold time of SO2, dust, nitrogen oxides, and fluorine in the atmosphere is 1-6 days, 3-7 days, 1-3 days, and 3-7 days, respectively. The average yearly ground level concentration of SO2 and nitrogen dioxide in polluted areas is 150 micrograms/cu m and 50 micrograms/cu m. Nuclear energy is about 1000 times less polluting than either coal or fuel oil, while natural gas is about 100 times better than the fossil fuels. The energy generation facilities operating currently are susceptible to creating considerable pollution even under normal meteorological conditions, while concentrations exceeding the maximum allowable levels by two orders of magnitude occur during inversions.

62869

Kovygin, G. F.

CERTAIN PROBLEMS OF SUBSTANTIATING THE PERMISSIBLE DENSITIES OF SURFACE CONTAMINATION WITH BERYLLIUM. (Nekotoryye voprosy obosnovaniya dopustimykh plotnostey zagryazneniya noverkhnostey berilliyem). Text in Russian. Gigiena i Sanit., no. 2:43-45, 1974. 1 ref.

The permissible density of surface contamination by beryllium was studied with respect to the redispersion of the surface contaminant and to the resulting in-the-air concentration of beryllium. Ammonium fluoroberyllate and metallic beryllium dust with a particle size of 50 micron, a fan providing for an air velocity of 1.8 m/sec were used for the experiments. Inverse correlation between the redispersion index; i.e., the ratio of the in-the-air aerosol concentration to the surface density of contamination, and the surface density of contamination was established. The correlation coefficient decreased with increasing air velocity. The maximum allowable surface contaminations that cause no aerosol contamination exceeding the maximum allowable beryllium concentration were 0.9 and 0.7 mg/sq m for ammonium fluoroberyllate and metallic beryllium without air movement, and 0.4 and 0.2 mg/sq m at 1.8 m/sec air velocity.

64013

Goddard, A. J. H., R. E. Holmes, and H. Apsimon

COMPUTATION AND MAPPING OF THE DISPERSION AND HERBAGE UPTAKE OF GASEOUS EFFLUENTS FROM INDUSTRIAL PLANTS. Society of Engineering Science, Pollut. Eng. Sci. Solutions, Proc. Int. Meet. Soc. Eng. Sci., 1st, Tel Aviv, Israel, 1972, p. 548-563, 1973. 16 refs. (June 12-17.)

Computer routines which enable rapid computation of air contamination downwind from complex release patterns are described. Routines exist whereby isopleths of ground level air concentration averaged over varying time intervals are automatically plotted for rapid appraisal. In addition, integrated air concentrations can be predicted for specified locations, such as air sampling stations, and these results printed out. Further routines compute the levels of contamination within plant and animal species as a function of time during the exposure. As an example of the application of some of the routines, the release of fluorides from aluminum smelting is discussed. The significance of aluminum smelting in the United Kingdom and emissions from the notional smelter are described. The relative significance of air and pasture contamination with fluorides,

human and animal toxicity, and plant toxicity are reviewed. Calculation of dispersion, computer mapping of concentrations of fluoride at ground level, and calculation of time-dependent herbage levels are discussed for the example of fluorides released from an aluminum notional smelter. The numerical results illustrate the application of this ecosystem pollution program to the initial analytical stages of this type of environmental study. The program provides rapid and readily comprehensible predictions of air and herbage contamination. By virtue of the low cost of operation, computations can be made to relate herbage monitoring and district air sampling results to specific variables such as significant changes in weather, seasonal changes in herbage growth rates, and changes in the release pattern of fluorides from the plant.

70747

Israel, G. W.

DEPOSITION VELOCITY OF GASEOUS FLUORIDES ON ALFALFA. Atmos. Environ., 8(12):1329-1330, Dec. 1974. 6 refs.

Fumigation of alfalfa and orchard grass with constant hydrogen fluoride levels for more than 16 days yielded a deposition velocity of 16 mm/sec as compared with an estimated deposition velocity for field crops of alfalfa and orchard grass of 31 + or - 16 mm/sec. The estimated average fluoride accumulation coefficient for field crops was about twice that derived from the fumigation studies, though the reason for the discrepancy was not established. The deposition velocity values for alfalfa were about 3-6 times higher than published deposition velocity values for sulfur dioxide on grass. This difference may be partially due to the relatively large leaf surface area of alfalfa per unit area of ground and the vertical spacing of the leaves. Assuming that atmospheric fluorides are admitted by ghe plant mainly through the leaves and that the effective fluoride absorption area is 5 sq m of leaf surface per sq m of ground surface, the alfalfa deposition velocity is similar to SO2 deposition velocities reported for grassland.

72995

Landsberg, H. E.

THE DEFINITION AND DETERMINATION OF CLIMATIC CHANGES, FLUCTUATIONS AND OUTLOOKS. Preprint, Maryland Univ., College Park, 19p., 1975. 36 refs. (Presented at the Atmospheric Quality and Climatic Change Symposium, Chapel Hill, N. C., March 21, 1975.)

The nature and nomenclature of various types of climatic change are discussed, with particular reference to anthropogenic climatic alterations. Urbanization with its associated heat island effect is responsible for alterations in temperature, humidity, and rainfall on a local scale, while industrialization produces regional changes in climate. An increase in carbon dioxide production on a global scale as well as an attendant increase in temperature result from the burning of fossil fuels as well as from urbanization and industrialization. Global effects involving ozone reduction and increased ultraviolet radiation result from aircraft flying in the stratosphere and from the release of man-made chemical compounds containing chlorine and fluorine. The possibility exists that certain elements of air pollution, if continued beyond a presently as yet unknown critical limit, might induce inrreversible processes such as polar ice melting or ice extension.

76047

Schneider, T., N. D. van Egmond, H. J. van de Wiel, A. C. Posthumus, M. van Leeuwen, P. Steenbergen, J. van Straaten

AIR POLLUTION CASE STUDY OF THE SOUTH HOLLAND REGION - FIRST PHASE (1973). National Institute of Public Health, Bilthoven (Holland), 105p., 1973 (?).

Air quality and meteorological parameters were measured in South Holland during 1973, with special emphasis on the components of photochemical smog. At Vlaardigen, the highest concentrations of most pollutants, especially acetylene, were found during the morning on days when atmospheric conditions were unstable. Winds from the north caused higher concentrations of the acetylene from traffic emissions. Winds from the southwest were accompanied by maximal concentrations of nitrogen dioxide, isobutane, butane, and propane, indicating that these pollutants originate at some distance from the measuring point. Higher concentrations of nitric oxide and ethene were found at very low wind velocities. The NO:NO2 ratio diminished with higher wind velocity for winds from all directions except the south-southeast. For higher wind velocities from this direction, a relatively high NO concentration was found, which might have come from a nitrogen oxides source at some distance from the station. Highest NO concentrations were found near highways. Data from mobile measurement units indicate that ground level concentrations of NO and NO2 in Vlaardingen originated from the Rijnmond industrial region 50% of the time; these pollutants can be traced to that source only 25-30% of the time in the Rotterdam-Schiedam region. Measured sulfuric acid concentrations were low. The small stinging nettle proves more sensitive than lettuce or grass to the effects of peroxyacetyl nitrate in the Westland region, and is a suitable plant indicator; tobacco was especially sensitive to ozone; and gladiolus and freesia were damage-sensitive to hydrogen fluoride. Hourly pollution measurements arranged in score diagrams facilitated the analysis of the interaction of pollutants with meteorological variables.

77970

Krey, P. W. and R. J. Lagomarsino

STRATOSPHERIC CONCENTRATIONS OF SF6 AND CCL3F. In: Health and Safety Laboratory Environmental Quarterly. Energy Research and Development Administration, New York, Health and Safety Lab., p. I-97-I-123, July 1975. 18 refs. NTIS: HASL-294

Because of the chemical inertness of freon-11 and sulfur hexafluoride in the environment, their concentrations in the stratosphere were measured as part of a study of global atmospheric diffusion. Compressed air samples were recovered from the stratosphere by aircraft. The SF6 and freon were concentrated and determined by gas chromatography. The stratospheric concentrations of freon and SF6 are given. The two trace gases behave similarly in the stratosphere. Although the Northern Hemisphere is the primary source of these gases, the similarity of their hemispheric distributions suggests a rapid interhemispheric exchange. The SF6 results are important because they demonstrate that halocarbons other than the freons have penetrated the stratosphere. The trace gas concentrations decrease with increasing altitude above the tropopause. Freon and SF6 concentrations in the stratosphere have spatial and seasonal distributions which are similar to lead 210 distributions from radon emanation at the earth s surface. An atmospheric box model is developed which indicates from the observed inventories that the photolytic half life of a freon 11 molecule in the stratosphere is 2 to 4 yr and the total atmospheric half life is 12 to 24 yr. (Author abstract modified)

78793

Brown, R. M., R. N. Dietz, and E. A. Cote

THE USE OF SULFUR HEXAFLUORIDE IN ATMOSPHERIC TRANSPORT AND DIFFUSION STUDIES. J. Geophys. Res., 80(24):3393-3398, Aug. 20, 1975. 9 refs.

The use of sulfur hexafluoride as a tracer in atmospheric transport and diffusion studies is discussed. Airborne and ground level concentration measurements using specially designed chromatographs were made. They illustrate the potential use of the method in tracking plumes from short or tall stacks and its ability to isolate and detect concentrations from a particular site. Meteorological input and other pertinent input information are used in a computer programmed model to compare measured versus calculated diffusion parameters. A measure of the standard deviation of the wind direction at plume height produces the best fit to the measured concentrations. The model is being developed to predict diffusion patterns and the concentrations from single and multiple source stacks. (Author conclusions modified)

78933

Bewers, J. M. and H. H. Haysom

THE TERRIGENOUS DUST CONTRIBUTION TO FLUORIDE AND IODIDE IN ATMOSPHERIC PRECIPITATION. J. Rech. Atmospheriques, 8(3-4):689-697, July-Dec. 1974. 31 refs. (Presented at the International Symposium on the Chemistry of Sea/Air Particulate Exchange Processes, Nice, France, Oct. 4-10, 1973.)

The terrigenous dust contribution to levels of fluoride and iodide in atmospheric precipitation is discussed. Fluoride and iodide have higher ratios to chloride in atmospheric precipitation than in seawater. While experimental evidence exists to propose a marine origin for the excess iodide, recent analyses indicate that fluoride is depleted in marine aerosols. This suggests a non-marine origin for the excess fluoride and airborne terrigenous dust is proposed as an alternative source. It is calculated that terrigenous dust, transported through the troposphere, does not account for more than 2% of the iodide and 4% of the fluoride in atmospheric precipitation. Unless injections from anthropogenic and volcanic activities are underestimated or other major sources exist, the oceans are the primary source of atmospheric iodide and fluoride and large positive enrichment occurs in the sea to air transport of these elements. (Author abstract modified)

78943

Duuren, H. van, G. D. Krijt, and A. J. Elshout

SULFUR HEXAFLUORIDE AS A TRACER FOR THE STUDY OF THE DISPERSION OF AIR POLLUTANTS EMITTED FROM PUNCTIFORM SOURCES. (Zwavelhexafluoride als tracer voor de verspreiding van luchverontreinigende componenten vanuit puntbronnen). Text in Dutch. Elektrotechniek, 53(3):135-143, March 1975. 20 refs.

The use of sulfur hexafluoride as a tracer in the study of the dispersion and conversion of air pollutants from point sources was investigated. The accuracy, defined as the variation coefficient v. 100%, of the determination of SF6 concentrations in the atmosphere is 20%. This is better than the accuracy that is obtained when the concentrations are calculated as in the case of dispersion from high sources. The degree of conversion of components such as sulfur dioxide, nitric oxide, and nitrogen dioxide in stack plumes is investigated.

79132

Galbally, Ian E.

GAS TRANSFER NEAR THE EARTH S SURFACE. Advan. Geophys., vol. 18B:329-339, 1974. 20 refs.

A mathematical method for relating gas uptake and adsorption at the earth s surface to the gas concentration in the air above the surface and the wind speed is derived. The resistance to gas transfer of the viscous layer at the surface-air interface and gas transfer in the turbulent constant flux layer are also examined. Gas uptake parameters are tabulated for hydrogen fluoride, iodine, chlori e, sulfur dioxide, nitrogen dioxide, ozone, nitric oxide, and carbon monoxide. Guidelines for estimating gas uptake at land surfaces are also presented.

F. BASIC SCIENCE AND TECHNOLOGY

01677

S.W. Benson G. Haugen

THE ELIMINATION OF HF FROM 'HOT' FLUORINATED ETHANES. AN ESTIMATION OF THE ACTIVATION ENERGIES AND RATE PARAMETERS. J. Phys. Chem. 69, (11) 3898-3905, Nov. 1965

The classical Rice-Ramsperger-Kassel theory of unimolecular reactions is shown to give a quantitative description of the decomposition of a 'hot' molecule of CH2FCH2F. The analysis also makes possible an estimate of the activation energy for the elimination of HF from this molecule within narrow limits: CH2FCH2F yields CH2 equal CFH plus HF; Eact equal 62 plus or minus 3 kcal./mole; delta E298K. equal 8 kcal./ mole. From the theory one predicts the observed reductions in the rate of the elimination reactions for the series of 'hot' molecules C2H6-xFx as x is increased. A similar analysis gives a theoretical explanation of the observed pressure dependence of the rates of stabilization of the 'hot' molecules (CH2Cl. CH2Cl), (CH2Cl.CHCl2), and (CHCl2.CHCl2). A quantum modicication of the classical Rice-Ramsperger-Kassel theory was found necessary when the magnitude of the unfixed internal energy approaches the size of a quantum of vibrational energy. This approximation of the classical theory predicted the correct rate of elimination of a Cl atom from the hot radical (CHClCHCl2) which at the transition state had only 2 kcal./mole of unfixed energy. In these calculations the carbon-carbon bond energy in ethane was assumed to be invariant upon the replacement of hydrogen by halogen atoms. (Author abstract)

02337

D. Phillips.

PHOTOLYTIC PROCESSES IN PERFLUOROCYCLOBUTANONE VAPOR. J. PHYS. CHEM. 70, (4) 1235-43, APR. 1966. CFSTI, DDC AD 635437

The photolysis of perfluorocyclobutanone in the vapor phase at 3130, 3340, 3660, and 4047 A has been investigated. Fluorescence and decomposition yields have been determined at the four wavelengths and the effects of pressure and temperature upon them studied. Two modes of decomposition occur at the shortest wavelengths and at high temperatures, one producing carbon monoxide and perfluorocyclopropane, the other producing tetrafluoroethylene. A mechanism is proposed which explains the results, and rate constants for reactions are determined. Results indicate that about 7 kcal/mole excess vibrational energy can be removed from the excited ketone by each collision with an unexcited ketone molecule. (Author abstract)

02517

D. Marsh and J. Heicklen

PHOTOOXIDATION OF PERFLUOROETHYL IODIDE AND PERFLUORO-N-PROPYL IODIDE. Aerospace Corp., El Segundo, Calif., Lab. Operations. Apr. 1966. 11 pp. DDC: AD 483914

Perfluoroethyl iodide and perfluoro-n-propyl iodide were photolyzed in the presence of oxygen. In both cases, the major product is CF20. In the C2F51 system, it is produced with a quantum yield of about 2.0. CF3CFO is also produced, but is 100 times less important. With HI present, the oxidation is drastically modified, and the RO2 intermediate must live at least 10 to the 7th sec. (Author abstract)

03062

S. W. Benson and G. R. Haugen.

ESTIMATED ACTIVATION ENERGIES FOR THE FOUR-CENTER ADDITION REACTION OF H2, HX, AND X2 TO ACETYLENES. J. Phys. Chem. 70, (10) 3336-8, Oct. 1966

The application of an electrostatic model to predict the activation energy of the four-center addition reactions of acetylene is discussed. The transition state is considered an intimate semi-ion pair with an equivalent charge separation of plus or minus formal charge. The energy of activation can be equated to the electrostatic energy of interaction of point dipoles. Values obtained for the reacting substances (acetylene, methyl acetylenes, hydrogen halides, hydrogen, fluorine, chlorine, bromine, iodine) are tabulated. The activation energy for the molecular addition to acetylenes is about 1.5 kcal/mole smaller than that for the corresponding olefin.

04468

OPTICAL SPECTRA OF SOME LOW-MOLECULAR WEIGHT COMPOUNDS USING THE MATRIX ISOLATION TECHNIQUE. IIT Research Inst., Chicago, Ill., Technology Center. (Rept. No. IITRI-U6001-11 - Quarterly Technical Summary Rept.) Feb. 13, 1966. 8 pp. DDC, AD 478 935

The object was the determination of thermodynamic functions of lowmolecular-weight compounds formed in the exhaust gases of rocket motors. Experiments were made to investigate the infrared spectra of; Li6BeF3 Li7BeF3 and Be2F4, BOF, Na2F2, NaA1F4, and CaA1F4.

04674

D. L. Bernitt, R. H. Miller, I. C. Hisatsune

INFRARED SPECTRA OF ISOTOPIC NITRYL HALIDES. Spectrochim. Acta 23A, 237-48, 1967.

The infrared spectra of nitrogen-14 0nd 15 isotopic species of nitryl chloride and fluoride were examined in the vapor and solid states. Assigments of two fundamentals in both halides were changed from those proposed by earlier investigators. A band at 1/460 cm reported earlier for the fluoride was shown to originate from an impurity. Thermodynmaic functions and new sets of force constants from both the valence and the Urey-Bradley force fields were calculated. (Author abstract)

04768

Mavrodineanu, R. and R. R. Coe

METHOD OF DISPENSING VOLATILE FLUORIDES IN PORTABLE GREENHOUSES. Agr. Food Chem., 5(11):852-854, Nov. 1957. (Presented at American Chemical Society, National Meeting, 130th, Division of Analytical Chemistry, Atlantic City, N. J., Sept. 1956.)

Equipment and procedures are described for producing nearly constant concentrations of fluosilicic or hydrofluoric acid in fumigating greenhouses ranging from less than one to several hundred parts per billion. The method makes use of diluted solutions (0.01 to 4%) of these acids which are atomized by an air pressure of 10 to 20 pounds per square inch through a platinum nozzle. The atomized droplets are than passed through an electrically heated tube (150 C) where they are changed to the gaseous state before delivery to the air stream entering the fumigating greenhouses. Given concentrations of volatile fluorides can be maintained nearly constant in the greenhouses for as long as 5 weeks. The functioning of the apparatus is not affected by changes in temperature, and 3 liters of solution are sufficient for 12 days of uninterrupted fumigation. (Author abstract)

07714

Derner, Harold A.

SEMIAUTOMATED DETERMINATION OF FLUORIDE IN URINE. Am. Ind. Hyg. Assoc. J., 28(4):357-362, July-Aug. 1967. 10 refs.

A procedure was developed, using the Technicon AutoAnalyzer, for the determination of fluoride in urine, which does not require ashing or fusion of the sample. The only interference encountered was chloride ion, which was easily removed by the addition of silver perchlorate to the acidified sample. Samples ranging down to 0.01 ppm F can be accurately analyzed at a rate of 10 to 15 per hour. Twenty milliliters of urine are made slightly acidic with perchloric acid in a 25-ml volumetric flask, chloride is precipitated by the addition of excess silver perchlorate solution, a portion of the sample is filtered, and the filtrate is analyzed by the AutoAnalyzer. The acuracy and precision of the procedure are reported, and the results obtained on the semiautomated method are compared with results obtained by using the manual Willard- Winter distillation. (Author's summary)

13565

Sanderson, R. T.

MULTIPLE AND SINGLE BOND ENERGIES IN INORGANIC MOLECULES. J. Inorg. Nucl. Chem., 30(2):375-393, Feb. 1968. 7 refs.

The new method of calculating bond energies recently reported (R. T. Sanderson, J. Inorg. Nucl. Chem., vol. 28:1553, 1966) has now been extended to include multiple bonds. For carbon-carbon double and triple bonds the energy is 1.50 and 1.75 times the single bond energy when corrected for the multiple bond length. These multiplicity factors are used to calculate the single bond energies for nitrogen and oxygen that would correspond to the experimental bond lengths and dissociation energies of N2 and O2. Three different single bond energy contributions each for nitrogen and oxygen are thus determined, and estimates are made for similar values for fluorine, phosphorus, sulfur, chlorine, bromine, and iodine. The possible significance of such values is discussed in terms of bond energy calculations for 141 gaseous molecules, based on a consideration of the effect of lone pair electrons in bond weakening. Calculated bond energies for CO, CO2, NO, NO2, and other compounds are in excellent agreement with the experimental values. (Author's abstract modified)

13998

Shaffer, J. H., W. R. Grimes, and G. M. Watson

SOLUBILITY OF HYDROGEN FLUORIDE IN MOLTEN FLUORIDES. I. IN MIXTURES OF NAF-ZRF4. J. Phys. Chem., 63(12):1999-2002, Dec. 1959. 25 refs.

Because of their value in nuclear fuel element reprocessing and their use as fuel for experimental nuclear reactors, mixtures of NaF and ZrF4 were chosen to investigate the solubilities of hydrogen fluoride at pressures from 0.5 to 3 atm and from 550 to 800 deg. The solubility of HF in all mixtures studied follows Henry's law and, in contrast to the behavior of noble gases in similar solvents, decreases with increasing temperature. As the mole percent of NaF in the solvent is increased from 45 to 80.5, solubility increases approximately tenfold. The enthalpy of solution, like the solubility, is dependent on the solvent composition. The values of entropies of solution are all negative and change only 1 e. u. over the range of solvent compositions investigated. The observed strong dependence of HF solubility on solvent composition may be related to the relatively high stability of NaF-HF compounds.

14907

Oelschlaeger, Walter

INFLUENCE OF THE ASHING METHOD ON THE RESULTS OF FLUORINE DETERMINATIONS. Staub (English translation from German of: Staub, Reinhaltung Luft), 28(12):25-27, Dec. 1968. 6 refs.

Errors in fluorine determinations of biological samples occur when ashing of samples is carried out in a muffle furnace. The analytic results are distorted because the furnace always contains relative high quantities of fluorine. At 450 C up to 40% F is simulated; at 550 C up to 390 F is simulated. For the investigation of samples which only contain a small amount of fluorine and to which CaO must be added before incineration, it is absolutely necessary to use a gas-tight muffle furnace lined with platinum plates. A furnace with nickel plate lining may be used in most cases for other vegetable samples and for hard tissues.

14970

Field, Paul E. and James H. Shaffer

THE SOLUBILITIES OF HF AND DF IN MOLTEN FLUORIDES. Oak Ridge National Laboratory, Oak Ridge, Tenn., CONF-660907-1, Rept. ORNL-P-2202, 17p., June 27, 1966. 7 refs.

The solubilities of HF and DF in molten LiF-BeF2 (66-34 mole %) were determined over the temperature range 500-700 C and at solute gas pressures between 1 and 2 atm. Using previously established experimental methods, the solubilities of both gases were found to obey Henry's Law. The Henry's Law constants, K(H) (0.0001 moles HF/mole melt-atm) for HF and DF respectively at 500, 600 and 700 C were approximately 3.37, 2.96, 2.16, 1.83, 1.51, and 1.25. The values given were obtained by a linear least squares fit of the experimental data as in K(H) vs. 1/T and the uncertainties are at the 95% confidence interval. The heat of solution, obtained from the least squares evaluation were approximately 5.98 and -6.43 kcal/mole for HF and DF respectively. The comparison of heat of solution for HF in this melt composition with those obtained previously in melts ranging from 54 to 89 mole % LiF in BeF2 reveals linear dependence of heat of solution on the mole fraction of LiF above and below 67% with a maximum at

67% LiF. Interpretation of the isotope effect is made by comparison of the difference in the entropies of solution between DF and HF with the difference in the calculated values of the entropies of the two gases at 600 C. (Author abstract modified)

15927

Varlamov, M. L., E. L. Krichevskaya, A. A. Ennan, L. M. Zampol'skaya, G. A. Manakin, and R. A. Georgalin

ACCOUSTIC COAGULATION OF MIST CONTAINING FLUORINE COMPOUNDS. J. Appl. Chem. USSR (English translation from Russian of: Zh. Prikl. Khim.), 41(11):2494-2499, Dec. 1968. 4 refs.

The efficiency of acoustic coagulation of aerosols containing fluorine compounds has been previously studied by chemical determinations of fluride contents before and after coagulation. In the present study, efficiency of sonic treatment was assessed by ultramicroscopic determinations of particle numbers per unit aerosol volume (number concentration) and both ultramicrosopic and photomicrographic determinations of particle size distribution. Determinations of particle number concentrations was made before and after acoustic coagulation of waste gas aerosols from a superphosphate granulation plant. The results show that the number of particles decreases by a factor of 100-1000 as the result of acoustic treatment for 3-5 sec. The results of determinations of particle size distribution before and after acoustic treatment are presented in the form of histograms and distribution curves. The form of the histograms suggest a Gamma-distribution. With the industrial mist, the number of particles deposited per unit area decreased by a factor of 125 after acoustic treatment for 1.5 sec, while the average diameter increased from 2.5 to 18.7 micron. Before treatment, 88% of the particles were in the 1-4 micron size range. Accoustic treatment shifts the distribution center to the right and increases the variance. Similar results were obtained from photomicrographs of mists deposited on greased glasses.

16218

Buff, H. and A. W. Hofmann

DISSOCIATION OF GASEOUS COMPOUNDS BY ELECTRICALLY INDUCED GLOWING. (Zerlegung gasfoermiger Verbindungen durch electrisches Gluehen). Text in German. Ann. Chem. Pharm., 113(2):129-150, 1860. 4 refs.

Gases and vapors of liquids with low boiling points were exposed to powerful sparking as produced by the Ruhmkoff induction coil, to glowing platinum and iron wires, and to the high temperature of the flame arc, and the dissociation was observed. The induction coil is best suited for dissociation of ammonia; all the other methods take too long. Dissociation of C2H5N begins immediately, but it is never complete. Dissociation of C6H9N and of C4H7N is slow and incomplete. Iron wires dissociated C2N completely but slowly; the flame arc is much faster. The induction coil is least suitable. Nitric oxide is dissociated rapidly by a glowing iron spiral and by the flame arc, and slowly by the induction coil. The dissociation is not complete. Similar results are obtained with NO2. None of the methods work with dry CO. Reduction of CO2 is slow with both the flame arc and the induction coil. The dissociation of CS2, C2H4, C4H4, SO2, HS, PH3, ClH and SiFl2 was observed in like manner, and the efficiency of each method was stated.

16370

Gatti, R. and H. J. Schumacher

THE KINETICS OF THERMAL REACTION BETWEEN F2SO3 AND NITROGEN DIOXIDE. (Die Kinetik der thermischen Reaktion zwischen Fluorfluorsulfonat (F2SO3) und Stickstoffdioxid). Text in German. Z Physik. Chem. Neue Folge (Frankfurt), 62(1-4):159-167, 1968. 4 refs. AD 686588

The reverse of the kinetics of thermal reaction between fluorosulfonate and 2 nitrogen dioxide yields nitrogen tetroxide; was studied between -10 C and +10 C in an aluminum vessel. The reaction is homogeneous and is influenced by neither the total pressure nor by the added oxygen. FSO3 NO2 and NO2F develop as sole products. The former occurs in the form of a white precipitation. The reaction speed is proportional to the concentrations of NO2 and F2SO3. A bimolecular reaction between NO2 and F2SO3 determines the reaction speed which follows the equations N2O4 yields 2NO2 and the reverse: NO2 + F2SO3 yields FSO3 + NO2F, and NO2 + FSO3 yields FSO3 NO2. The activation energy of the first reaction is 9.970 plus or minus 200 cal; its probability factor is 0.0036.

18427

Benesi, H. A. and C. P. Smyth

MOLECULAR ASSOCIATION IN HYDROGEN FLUORIDE VAPOR. J. Chem. Phys., vol. 15:337, May 1947. 8 refs.

Ring structure in molecular association in hydrogen fluoride vapor was studied by measuring the dielectric constant of the vapor and calculating its polarization. Two curves were run for polarization as a function of pressure, one at 26.0 and the other at 38 C, temperatures at which association has been established. For pressures above 120 mm at 26.0 and 160 mm at 38.0, the polarization rose rapidly with increasing pressure. The large increase in polarization brought about by molecular association shows that ring structures, which would decrease the polarization, cannot predominate; the presence of more or less extended chains, which increase polarization due to their large dipole moments, is clearly indicated.

18863

Bryant, G. W.

THERMOELECTRIC POWER OF SINGLE CRYSTALS OF ICE CONTAINING HF OR HN3. Phil. Mag., 16(141):495-504, Sept. 1967. 12 refs.

The homogeneous thermoelectric power of single-crystalline ice containing hydrogen fluoride or ammonia was measured over a wide range of concentrations. The experimental values were of the order of a few millivolts per degree centigrade and varied in sign and magnitude with the type and concentration of impurity in agreement with the theory developed by Jaccard. A quantitative comparison with the theory enabled the calculation of several physical parameters relating to the electrical properties of ice. (Author abstract modified)

19175

Ashton, J. T., R. A. Dawe, K. W. Miller, E. B. Smith, and B. J. Stickings

THE SOLUBILITY OF CERTAIN GASEOUS FLUORINE COMPOUNDS IN WATER. J. Chem. Soc., no. 8:1793-1796, 1968. 22 refs. CFSTI, DDC: AD 678233

An apparatus designed for especially low solubilities was used to determine the solubilities of tetrafluoromethane, sulfur hexafluoride, and nitrogen trifluoride in water from 0 to 50 deg, while the changes in heat content and entropy were estimated

from the temperature-dependence of the solubilities. The apparatus, sensitive to gas solubilities on the order of 10 to the minus 6th power mole fraction, differs from its predecessors in that it allows the bulk of gas measurement to be performed under 'dry' conditions, or in other words unsaturated with solvent vapor. An additional arm of the solubility vessel acts as a manometer, allowing the pressure to fall as the gas is dissolved, permitting equilibrium to be reached more rapidly. On the basis of observations and a review of the literature, it was concluded that the low solubilities of fluorinated gases are not due to specific anomalous factors that cause large negative entropies of solution, but the entropies appear to be related to the relatively larger size of the fluoride molecules in comparison with the inert gases, which are most frequently used as comparison standards.

20932

Mueller, Robert F.

ENERGETICS OF HCL AND HF IN VOLCANIC EMANATIONS. Preprint, National Aeronautics and Space Administration, Greenbelt, Md., Goddard Space Flight Center, 32p., June 1969. 37 refs. (Paper NASA-TM-X-63608.) CFSTI: N69-32034

Thermochemical data were used to calculate the fugacities of HCl and HF in equilibrium with halogen salts and crystalline silicates. The calculated fugacities were compared with the abundances of HCl and HF in fumarolic gases. Good agreement between the calculated values and the results of hydrothermal experiments were obtained. In the case of fumaroles, the abundances of HCl and HF molecules can be explained by assuming some undersaturation of the systems in such crystalline components as NaCl, CaSiO3, and Al2SiO5. Also, the fumarolic gases gave evidence that high temperature abundances of HCl and HF are quenched to much lower temperatures recorded at the fumarolic vents. Numerous determinations of Cl and F in igneous and crystalline rocks showed that on the whole, F is more abundant than Cl. Igneous rocks and minerals are quite distinct from volcanic emanations in terms of the F/Cl ratios. The relations between HCl and HF and the structure of the silicate melt were also discussed. Although heterogeneous equilibria may be established at high temperatures between the the halogen gases and crystalline phases of the wall rock, the ultimate source of most of the halogens is the silicate melt. Although the structure of such melts is not well known, it is reasonable that both the decrease in liquidus temperatures and viscosity are attributable to reactions in which the Si-O-Si bridges are destroyed by the reaction with water. (Author abstract modified)

21389

Grahame, David C. and Barbara A. Soderberg

IONIC COMPONENTS OF CHARGE IN THE ELECTRICAL DOUBLE LAYER. J. Chem. Phys., 22(3):449-460, March, 1954. 17 refs.

The rate of change with concentration of the capacity of the electrical double layer on mercury has been measured. From this the excess of cations in the double layer and the excess of anions have been calculated. The latter has been subdivided into the excess of anions in the diffuse double layer, and the excess of anions in the inner part of the double layer. From these data it has also been possible to evaluate the potential of the outer Helmholtz plane. It is found that fluoride ion remains unadsorbed on mercury at all potentials investigated, including potentials anodic to the e.c.max. Other anions are strongly adsorbed (chemisorbed) when the mercury is positively charged, and sometimes even when it is negatively charged. The 'hump' in the capacity curves of salts of such anions as chloride, bromide, acetate, and nitrate, are found to be present in curves of the capacity attributable to anions alone. No chemisorption of monatomic cations could be detected. The kinetic theory of the diffuse double layer with constant dielectric constant is found to fit the experimental results within the expected accuracy. This fit extends to electrolytes of the 1:2 and 2:1 types also. A new method of evaluating salt adsorption at the potential of the electrocapillary maximum (e.c.max.) is described and results are given. Likewise a new method of determining the capacity attributable to cations at the e.c.max. is described and used. (Author abstract)

21632

Kessel'man, P. M., M. M. Afanas'yev, A. S. Bestuzhev, Yu. I. Blank, S. F. Gorykin, P. A. Kotlyarevskiy, S. K. Chernyshev, and S. A. Shchekatolina

HEAT CAPACITY OF GASES AT ELEVATED TEMPERATURES WITH ACCOUNT OF THEIR NONIDEALITY AND THERMAL DISSOCIATION (H2O, CO2, F2, AIR, LITHIUM AND FUEL COMBUSTION PRODUCTS). Teplo- Massoperenos, vol. 7, 1968. 6 refs. Translated from Russian. Foreign Technology Div., Wright-Patterson AFB, Ohio, Translation Div., p. 152-157, Aug. 20, 1969.

A method of calculating the heat capacities Cp and Cv of chemically reacting gases is considered which takes into account their nonideality. Deviation from nonideality, when calculations are made of properties of pure components, equilibrium compositions, and compositions of mixtures, is allowed for by the second and third virial coefficients, which ensures adequate precision of results for the entire range of parameters investigated. Calculations of equilibrium compositions are carried out by solving a system of nonlinear algebraic equations, a specific form of which is determined in the individual case by the equations of the corresponding chemical reactions, equations of material valance of atoms, and the condition (Sigma) xi equals l. Since in the general form, solution of this system does not appear possible, equilibrium compositions were determined by the iterative method on an electronic digital computer at specified values of T and p. This method is applicable to the calculation of detailed tables of isobaric and isochoric heat capacities for water vapor, carbon dioxide, fluorine, air, lithium, and the combustion products of 13 organic fuels throughout the entire range of temperatures and pressures of practical importance (up to 6000 K and 0.1-1000 bar). An example is given for the isobars of the specific heat capacity Cp for one of the most complex systems of the groups under study (combustion products of a stoichiometric mixture of Saratov gas and air).

22219

Warburg, Otto and Walter Christian

CHEMICAL MECHANISM OF THE FLUORIDE-INHIBITION OF FERMENTATION. (Chemischer Mechanismus der Fluorid-Hemmung der Garung). Kurze Originalmitteilungen, vol. 39:194, 1941. Translated from German. Belov and Associates, Denver, Colo, 2p.

The chemical mechanism of inhibition of the ferment enolase by fluoride was investigated. Fluoride inhibition of three compounds was being determined: fluoride, magnesium salt, and phosphate. When the magnesium concentration was constant and the fluoride and phosphate varied, the equation phosphate times fluoride times remainder of effect/inhibition of effect equal constant was found. When the phosphate concentration was constant and the fluoride and magnesium salt varied, the equation magnesium salt times fluoride times remainder of effect/inhibition of effect equal constant was found. Since it is

difficult to determine such a small phosphate concentration, the equation was not tested for large fluoride concentrations. However, both equations were tested and found to be valid for fluoride concentrations of 1/20,000 to 1/100. It was concluded that the effective compound for fluoride inhibition is a complex magnesium-fluoro-phosphate. This compound combines in proportion to its concentration with the ferment protein in a dissociating manner. The specific reversible inhibition is believed to be based on the displacement of the effective magnesium salt from the protein by the complex.

25636

Kistiakowsky, G. B.

TERMINAL PROGRESS REPORT ON PUBLIC HEALTH SERVICE RESEARCH GRANT AP00349, 1/1/64 TO 12/31/68. Harvard Univ., Cambridge, Mass., 3p., May 15, 1969. 3 refs.

Research for the period 1/1/64 to 12/31/68, financed by Public Health Service Grant AP00349, is summarized. Some of the research is described in papers published by scientific journals. Some unpublished work described in a Ph.D. thesis is presented. The photolysis of 2,2,2-trifluorodiazoethane was carried out over a variety of conditions using standard photochemical techniques. Runs were also made with mixtures of carbon monoxide, nitrogen, and octafluorocyclobutane, and the reaction products were studied. Reactions mechanisms were postulated to explain butene/ethylene curves. Data on the reaction of methylene(generated photochemically from ketone) with iso-butane is discussed.

26990

Posner, A. S. and E. D. Eanes

FLUORIDE IN BONE AND TEETH. Norelco Rep., 10(2):71-74, 80, April- June 1963. 27 refs.

Experiments are reported to investigate the inverse proportionality of fluoride concentration in human bones with bone citrate content and to determine whether fluoride in some way alters the specific surface of the bone crystal surfaces on which citrate is found. Post-mortem bone samples were obtained from 20 long-time residents of different areas with water supplies of 0.1-4.0 ppm fluoride content. In X-ray diffraction studies of the ashed samples, the degree of resolution of the four principal X-ray reflections of the bone apatite pattern was used as a measure of 'crystallinity' of each sample, when matched with one of a series of templates constructed to represent the apatite X-ray pattern with different broadening functions. An infrared study was also conducted on samples of human and rat dental enamel to investigate the possible existence of a calcium-deficient apatite as the major phase in hard tissue. It was found that, in general, the crystallinity of the bone apatite increases as the fluoride content of the bone ash increases. The data indicate that fluoride stabilizes bone (1) by increasing the crystal size and/or decreasing the crystal strain, and (2) by changing the stoichiometry to that of a more stable form of apatite. An effect of fluoride on the diminution of the crystal surface was not conclusively demonstrated, and both the role of citrate in bone and the mechanism which causes ingested fluoride to alter the crystal structure of bone apatite remain to be elucidated.

28428

Chaix, Paulette and Claude Fromageot

THE EFFECT OF SODIUM FLUORIDE AND OF MONOIODACETIC ACID ON THE ANAEROBIC AND AEROBIC DECOMPOSITION OF SOME SUBSTRATES BY PROPIONIBACTERIUM PENTOSACEUM. (Influence du fluorure de sodium et de l'acide monoiodacetique sur les degradations anaerobie et aerobie de quelques substrats par Propionibacterium pentosaceum). Text in French. Enzymologia, 7(5-6):353-361, 1939. 21 refs.

The effect of different concentrations of sodium fluoride and monoiodacetic acid on the anaerobic and aerobic metabolism of glucose, lactic, and pyruvic acid by Propionibacterium pentosaceum in a non-proliferating state was studied. At a concentration of 0.02 M, sodium fluoride completely inhibits the anaerobic decomposition of glucose and lactic acid but has only a weak effect on the anaerobic decomposition of pyruvic acid. At the same concentration the fluoride has practically no effect on the aerobic metabolism of the three substances other than to raise to one the respiratory quotient of glucose which in a phosphate medium is somewhat lower (0.85). Monoidacetic acid at a 0.0004 M concentration was found to completely inhibit glucose fermentation while its effect on the oxidation of the same substrate was relatively weak. The effect on the aerobic decomposition of lactic acid was practically nil even at a lactic acid concentration of 0.01 M.

32952

Colussi, A. J. and H. J. Schumacher

THE THERMAL REACTION BETWEEN SF5OF AND NO2. J. Inorg. Nucl. Chem., 33(8):2680-2682, Aug. 1971. 3 refs.

The reaction between SF5OF and nitrogen dioxide was studied in nickel and aluminum vessels which were conditioned to fluorine and its compounds. In the nickel vessel, the reaction took place readily at room temperature, but in the aluminum vessel, the temperature had to be raised to about 80 C. The reaction was heterogeneous and was completed without change in the number of moles of gas. The products contained the expected quantity of SOF4 and nitrosyl hypofluorite in place of nitrylfluoride. The ONOF had characteristic bands in the infrared at 1713, 1302, and 885/cm and could be isomerized to FNO2.

34948

NEW DIRECTIONS IN ION-SELECTIVE ELECTRODES. Chem. Eng. News, 48(27):40-41, June 29, 1970.

Ion-selective membrane electrodes measure the activities of unassociated ions in solution with a sensitivity often less than one part/billion. The selectivity of the electrodes is such that they can be used in electrolyte solutions containing other species either present naturally or added to control the ionic strength and pH of the solution. There are now more than 20 electrodes available for more than 20 ions, including alkali and alkaline earth ions, heavy metal ions, and a wide variety of anions such as fluoride, nitrate, sulfide, and perchlorate. In recent work, ion-selective electrodes were used to measure formation constant in adenosine triphosphate complexes, complex formation of calcium, magnesium, and beryllium ions with biologically important ligands, and lead in urine samples.

39861

Seligman, Richard

ALUMINIUM PRODUCTION BY ELECTROLYSIS: A NOTE ON THE MECHANISM OF THE REACTION. J. Inst. Metals, 17(1):141-144, 1917. 3 refs. (Presented at the Institute of Metals, Annual Meeting, London, England, March 21, 1917.)

The conventional formula for the production of aluminum by electrolysis of a fused mixture of cryolite and alumina is Al203 + 3C equals 3CO + Al2. Experiments in an electric furnace indicate that this formula, which assumes a carbon consump-

tion very near to theoretical, is not correct. A carbon consumption well below the theoretical was attained and the fact that carbon monoxide is not necessarily the sole gaseous product of the reaction was demonstrated. Whether oxygen, carbon dioxide, or carbon monoxide result from the reaction depends on such factors as temperature, current density, physical properties of the anode, and the rapidity with which the gases are removed from contact with the anode.

41543

Badoz-Lambling, J., M. Herlem, A. Thiebault, and G. Adhami

THE REACTIONS OF SO3 AND SBF5 WITH FLUOROSULFURIC ACID. Anal. Letters, 5(5):305-307, 1972. 5 refs.

Fluorosulfuric acid is a good donor of sulfur trioxide, and as a result it reacts with antimony pentafluoride to give hydrogen antimony hexafluoride and SO3. Solutions of SO3 and SBF5 in HSO3F exhibit the same cathodic waves at platinum and platinized platinum electrodes. Electrochemical reductions at a potential corresponding to the plateau of these waves produces S sulfur dioxide and not hydrogen gas. This work confirms previous experimental evidence for the formation of SBF6- and SB2F11- ions on the basis of 19F nonmagnetic radiation spectra of SbF5-HSO3F solutions. (Author abstract modified)

44721

Shapiro, J. L.

TESTIMONY OF DR. J. L. SHAPIRO. CURRENT POWER GENERATION TECHNOLOGY. In: Problems of Electrical Power Production in the Southwest. Part I. 92nd Congress (Senate), 1st Session, p. 531-605, 1971. 59 refs. (Hearings before the Committee on Interior and Insular Affairs, May 24, 1971.) GPO

Current power generation technology is reviewed. Many new schemes have been proposed for central station power generation, including coal gasification or liquefaction, fluidized bed combustion, fusion reactors, geothermal, solar energy, tidal energy, and the use of magnetohydrodynamic generators. Condenser cooling technology, developed and employed within the U. S. for steam-electric generating plants during the past seven decades, includes once-through cooling systems and evaporative cooling tower systems. Cooling technology currently being developed includes once-through cooling systems with condenser by-pass dilution and once-through systems combined with evaporative cooling towers. Pollution control processes for the following pollutants are described: fly ash, sulfur dioxide, nitrogen oxides, and trace elements, especially fluorine and mercury. Cyclone, electrostatic precipitator, and wet scrubber collection systems and their efficiencies are described.

46162

Hancock, J. K. and W. H. Green

LASER-EXCITED VIBRATIONAL RELAXATION STUDIES OF HYDROGEN FLUORIDE. J. Chem. Phys., 56(5):2474-2475, March 1, 1972. 9 refs.

Room temperature rates of vibrational deactivation of hydrogen fluoride by HF, argon, nitrogen, deuterium, hydrogen, and carbon dioxide are reported. Laser-induced fluorescence experiments were carried out using a transverse electrode HF chemical laser as a pumping source. The fluorescence signals were monitored with gold:germanium and indium:antimony detectors, which, with the associated electronics, had time responses of 0.25 and 1.0 microsecond, respectively. The energy transfer properties of HF are of great importance in HF and HF-CO2 (transfer) chemical lasers.

52013

McCaldin, Roy O.

CONTROLLED ATMOSPHERES FOR AIR POLLUTION STUDIES. Florida Univ., Gainesville, Coll., of Engineering, Thesis (Ph.D.), Ann Arbor, Mich., Univ. Microfilms, Inc., June 1958, 162p. 79 refs.

Design and operation of a static chamber to contain atmospheric pollutants are described. A specific method of achieving known gas concentrations and the various means by which these concentrations become reduced within the chambers are described. The static chamber affords a simpler device because less instrumentation is required to achieve a test atmosphere, and once the atmosphere is achieved, it affords a uniform aand relatively stable atmosphere with which to work. The hypodermic syringe with a needle was used to inject measured quantities of study gas into the chamber. The hypodermic syringe feed method was reasonbaly accurate for volumetric measurements. The adsorption of gas on the chamber walls was studied for sulfur dioxide, hydrogen sulfide, and hydrogen fluoride. Toxicological, bacteriological, physiological, and odor studies are reported. Calibration methods are mentioned.

53153

Spicer, Chester William, Jr.

KINETIC STUDIES OF SOME REACTIONS OF SO2, NO, AND NO2. Pennsylvania State University, Dept. of Chemistry, Thesis (Ph.D.), Ann Arbor, Mich., Univ. Microfilms, Inc., Dec. 1971, 126p. 71 refs.

Reaction schemes, kinetic considerations, and mechanistic hypotheses are presented for the reaction of nitrogen dioxide with tetrafluoroethylene, the photolysis of sulfur dioxide in the presence of C2F4, and the reactions of methylperoxy radicals with nitric oxide and nitrogen dioxide. A low value corresponding to the Arrhenius preexponential factor for the acetyl fluoride (O2NCF2CFO) in the first set of experiments runs contrary to other indications of homogeneity, and no definitive explanation for such a preexponential factor can be offered. The electronic states involved in chemical reaction when SO2 is irradiated at 3130 A in the second series of experiments are clearly different from the emitting states. The fact that addition of NO could not completly quench the chemical reaction indicates two such non-emitting states, one a singlet and one a triplet. The crucial feature of the last study is that the methylperoxy radical does not react with NO to produce a methoxy radical and NO2 nor with NO2 to produce the CH3O radical.

55415

Haut, H. van

TEST CHAMBER METHOD FOR DETECTION OF PHYTOTOXIC AIR POLLUTANTS. (Testkammerverfahren zum Nachweis phytotoxischer Immissionskomponenten). Text in German. Environ. Pollut., 3(2):123-132, 1972. 12 refs.

Portable exposure chambers have been developed in which plants are exposed to filtered and unfiltered air for the purpose of identifying the presence of phytotoxicants in the air. The chambers consist of a plexiglass cap covering the plants to be exposed and a box below containing an air filter, blower, and watering system; an experimental unit includes at least two such chambers. Ambient air is passed directly through the test chamber and is filtered before entering the control chamber in order to remove any phytotoxicants present. The effects of pollutants can be accurately identified by comparison of the plant reactions in both chambers. Individual pollutants can be identified by using special filtering systems and

with combinations of indicator plants with differing resistance. A filter material coated with silver and silver oxide is used to remove the most important pollutants, sulfur dioxide, hydrogen fluoride, and hydrogen chloride. The filter material is also very effective in preventing leaf injuries to the tobacco variety BEL W3 which is very sensitive to oxidants. The exposure chambers may be used to conduct fumigation experiments both in the field and in climatic chambers as well as to test pesticides.

57580

Crawford, V. A. and F. C. Tompkins

THE ADSORPTION OF GASES ON CALCIUM FLUORIDE. Trans. Faraday Soc., vol. 46:504-514, 1950. 13 refs.

The adsorption of sulfur dioxide, nitrous oxide, and carbon dioxide on calcium fluoride crystals was measured at -28.8, 0.0, 19.4, and 35.5 C. Measurements were considered in terms of the nonuniformity of the adsorbent surfaces. Net heat of adsorption and distribution of adsorption sites were described by the Brunauer-Temkin, Freundlich, and De Boer-Bradley-Palmer isotherms. Analysis showed that SO2 on CaF2 will obey the De Boer-Bradley-Palmer equation over a wide range of pressures. The Freundlich equation is more satisfactory for the non-polar gases. Distribution of sites is affected by the nature of adsorbate-adsorbent forces, not by the nature of the non-uniformity of the solid adsorbent alone. Electrostatic forces predominate in the adsorption of a highly polar adsorbate. The edges and corners of the crystal will be low energy sites. Dispersion forces are important in the adsorption on non-polar gases. The edges and corners will be high energy sites.

57581

Crawford, V. A. and F. C. Tompkins

THE ADSORPTION OF GASES SO2, NH3, CO2 AND N2O ON BAF2 CRYSTALS. Trans. Faraday Soc., vol. 44:698-708, 1948. 15 refs.

The adsorption of sulfur dioxide, carbon dioxide, ammonia, nitrous oxide on barium fluoride crystals was measured over the temperature range -78 to 119 C. The values obtained were corrected for adsorption on the glass walls of the apparatus used. The adsorption of the four gases was reversible and complete within 5 min at all temperatures. No correction was necessary for deviations from the perfect gas equation in the pressure range used. Heats of adsorption were calculated from the isotherms using the Clausius-Clapeyron equation and the B.E.T. equation. There was no constant variation in heats of adsorption with temperature, but the variation decreased with increased adsorption for all the gases. The decrease of heats with coverage that was found experimentally was discussed and compared with those expected theoretically. Variation in adsorption potential over the crystal surfaces were calculated in an approximate manner, and the significance of these were discussed from the viewpoint of the applicability of the B.E.T. multilayer theory.

59528

Homann, K. H. and D. I. MacLean

STRUCTURE OF FLUORINE SUPPORTED FLAMES. II. CONCENTRATION PROFILES FOR FLAME OF THE SYSTEMS: H2-F2, H2-F2-NH3, NH3-F2, C2H2-F2 AND C2H4-F2. Boston Coll., Chestnut Hill, Mass., Dept. of Chemistry, Office of Naval Research Contract NOOO14-69-A-0453, Task NR-92-536/4-25-69(473), FRK-117, 30p., May 1972. 13 refs. NTIS, DDC: AD 743501

Concentration profiles of reactants, stable products, and reactive intermediates were measured in low pressure flames of the following systems burning on a multi-diffusion burner: hydrogen- fluorine, hydrogen-fluorine-ammonia, acetylene-F2, and ethylene-F2. In the first system, preliminary results for the H2 and F-atom profiles were in good agreement with independent measurements of the elementary reaction F + H2 yields hydrofluoric acid + H. In the H2-F2-NH3 system, ammonia acts as an inhibitor in the H2-F2 flames due to the formation of solid ammonium fluoride. The main products of the C2H2-F2 flame are HF and carbon fluoride (CF2). The CF2 recombines to C2F4 when the burned gas is cooled. The nature of the intermediates indicates that addition reactions of F and F2 to unsaturated hydrocarbons and their radicals, respectively, are important. The formation of soot in this flame is compared to that in an acetlyene-oxygen flame. Since a large amount of C2H4 is decomposed to C2H2 in primary reactions of the C2H4-F2 system, the concentration profiles in this flame are very similar to those in a C2H2-F2 flame. (Author abstract modified)

62189

Ludwig, C. B., W. Malkmus, J. E. Reardon, and J. A. L. Thomson

HANDBOOK OF INFRARED RADIATION FROM COMBUSTION GASES. National Aeronautics and Space Administration, Washington, D. C., Marshall Space Flight Center, 497p., 1973. 215 refs. NTIS: NASA SP-3080

Data is presented on radiative transfer in masses of combustion gases and flames. Radiant emission and absorption by combustion gases is reviewed. Typical applications include rocket combustion chambers and exhausts, turbojet engines and exhausts, and industrial furnaces. Some mention is made of radiant heat transfer problems in planetary atmospheres, in stellar atmospheres, and in reentry plasmas. Particular consideration is given to the temperature range from 500 to 3000 K and to the pressure range from 0.001 to 30 atmospheres. Strong emphasis is given to the combustion products of hydrocarbon fuels with oxygen, specifically to carbon dioxide, water vapor, and carbon monoxide. Species such as hydrogen fluoride, hydrogen chloride, cyanide, hydroxide, and nitric oxide are also discussed. A qualitative discussion is given of molecular radiators, molecular spectra, and radiative heat transfer in nongrey gases. The procedure for evaluating heat transfer from a given flow system is outlined, and guidelines for practical application of the handbook are given. Detailed discussions are presented on the properties of gaseous radiators and theoretical models for spectral emission from homogeneous and nonhomogeneous gases. Properties of the most commonly occurring molecules are tabulated, and specific computational models for these molecules are discussed. Emission from particle clouds and scattering effects in such clouds are discussed. (Author introduction modified)

68048

Vyakhirev, D. A., L. Y. Reshetnikova, L. I. Slyusareva, N. V. Stankova, and T. N. Shuvalova

COMPOSITION OF THE VOLATILE PRODUCTS OF THE THERMOOXIDATIVE DECOMPOSITION AND COMBUSTION OF POLYMERS. (Sostav letuchikh produktov termookislitelnogo razlozhenlya i gorenlya polimernykh materialov). Text in Russian. Plast. Massy, no. 9:59-61, 1974. 3 refs.

The volatile products of the oxidation of different polymers, such as polycarbonate, polymethylmetacrylate, polymer-coated glass fabric, capron, polyvinyl chloride, fluorine-containing and other rubbers, adhesive tape, and divinylstyrenecarboxy-

late latext at 300, 600, and 850 C were studied by gas-liquid chromatography with flame-ionization detector. Carbon dioxide, carbon monoxide, as well as saturated and unsaturated hydrocarbons were consistently present in the reaction products. Both the CO and CO2 contents increased with the temperature. Nitrogen oxides and ammonia were found in the oxidation products of synthetic rubber and nitrocellulose. The hydrochloric acid content of the combustion products of PVC was 54.7% at 300 C, 50% at 600 C, and 49.2% at 850 C. Perfluoroisobutylene and carbonyl fluoride were the most toxic products of fluorine- containing rubber. Aliphatic amines, benzene, toluene, n-xylene, divinyl methylmetacrylate, hydrofluoric acid, hydrogen sulfide, vinyl chloride, butylamine, formaldehyde, and phosphine were detected during the combustion of various polymers.

69599

Chu, Chao-kang and Edgar Heckel

RADIATION INDUCED HYDROGEN FLUORIDE FORMATION IN FLUORINE CONTAINING ETHANES AND ETHENE. Preprint, East Carolina Univ., Greenville, N. C., Dept. of Chemistry, 18p., 1974. 32 refs.

Several fluorine containing ethanes and trifluorethane formed hydrogen fluoride when irradiated with gamma rays in the gas phase at 25 C. Identical hydrogen fluoride yields were observed both in the absence and presence of molecular oxygen (except for monofluoroethane), indicating that hydrogen fluoride is formed by molecular eliminaton. A reduction in the radiation chemical yield (number of hydrogen fluoride molecules formed per 100 electron volts of energy absorbed by the sample gas) with increasing sample pressure indicated that collisional stabilization of excited fluorethane molecules completes with the process of molecular hydrogen fluoride elimination. High radiation chemical yields for hydrogen fluoride and carbon dioxide in mixtures of trifluoroethane and oxygen indicated the occurrence of a chain reaction. (Author abstract modified)

78035

Clyne, M. A. A. and L. W. Townsend

RATE CONSTANT MEASUREMENTS FOR RAPID REACTIONS OF GROUND STATE SULPHUR 3P4(3PJ) ATOMS. Intern. J. Chem. Kinet., vol. 1975:73-84, 1975. 39 refs. (Presented at the Symposium on Chemical Kinetics Data for the Upper and Lower Atmosphere, 1st, Warrenton, Va., Sept. 15-18, 1974.)

Atomic resonance fluorescence was used to directly detect ground-state atomic sulfur (S(3Pj)) for the first time in a discharge flow system. Concentrations of S(3Pj) atoms between 1.0 times 10 to the 10/cu cm and 1.4 times 10 to the 12/cu cm were measured. The rate constants at 298 K for the bimolecular reactions of S(3Pj) with molecular oxygen, nitrogen dioxide, ozone, molecular fluorine, molecular chlorine, and molecular bromine were: 1.5 + or - 0.3 times 10 to the -12, 6.2 + or - 1.4 times 10 to the -11, 1.2 + or - 0.3 times 10 to the -11, 2.9 + or - 0.8 times 10 to the -13, 1.1 + or - 0.1 times 10 to the -11, and 9.5 + or - 1.7 times 10 to the -11 cu cm/molecule/sec, respectively. The ground state sulfur atom appeared to be more reactive than the analagous ground state oxygen atom. (Author abstract modified)

80516

McDowell, C. A., F. G. Herring, and J. C. Tait

ELECTRON PARAMAGNETIC RESONANCE STUDY OF HYDROGEN AND FLUORINE ATOM ADDITION TO SO2. J. Chem. Phys., 63(8):3278-3283, Oct. 15, 1975. 25 refs.

The electron paramagnetic resonance spectrum of the species formed in the near ultraviolet photolysis of mixtures of argon or krypton containing 1% hydrogen iodide and sulfur dioxide, 1% CF3OF and SO2, or F2SO2 was investigated at 4.2 K. The species formed when an HI/SO2 mixture is photolyzed was the symmetric sigma radical HSO2. The assignment of the principal components of the g and hyperfine tensors is aided by observation of preferential orientation of the trapped radical. The species formed when a CH3OF/SO2 mixture was photolyzed in the far ultraviolet was the symmetric sigma radical FSO2. The g and A tensors were determined from an exact solution of the spin Hamiltonian assuming a noncollinear tensor axis system. (Author abstract modified)

81069

Skolnik, Edward G., Stephen W. Veysey, Mahmooda G. Ahmed, and William E. Jones

RATE CONSTANTS FOR THE REACTION OF FLUORINE ATOMS WITH NITRIC OXIDE IN THE PRESENCE OF VARIOUS THIRD BODIES. Can. J. Chem., 53(21):3188-3193, Nov. 1, 1975. 20 refs.

The absolute rate constants for the reaction of fluorine atoms with nitric oxide in the presence of argon, helium, neon, nitrogen, nitric oxide, carbon dioxide, carbon tetrafluoride, and hexafluoroethane are reported. The reaction of F2 atoms with NO in the presence of a third body produces nitrosyl fluoride in both ground and excited electronic states. The electronically excited FNO molecules decay to ground state FNO by both radiative and nouradiative processes. In addition to reaction with NO, F2 atoms may be lost by a wall reaction. The values are compared to those found for reactions of chlorine, hydrogen, and oxygen with NO. (Author abstract modified)

81496

Byler, D. M. and D. F. Shriver

THE VIBRATIONAL SPECTRA OF ANTIMONY PENTAFLUORIDE-SULFUR DIOXIDE (1/1). Inorg. Chem., 15(1):32-35, Jan. 1976. 20 refs.

Complete solid state Raman and infrared spectra are reported for the antimony pentafluoride-sulfur dioxide (1:1) complex, and assignments are made for the fundamental vibrations. Depolarization data are reported for the liquid-phase Raman spectra. The antimony-oxygen stretch in the complex is assigned to a band at 266/cm; this falls at a lower energy than does antimony-nitrogen for the analogous acetonitrile complex of antimony pentafluoride. The three fundamental vibrations ascribed to the sulfur dioxide moiety of the antimony pentafluoride-sulfur dioxide complex are assigned to Raman bands at around 1320, 1100, and 539/cm; these are shifted approximately -15, -45, and +15/cm from the values found for the equivalent modes in free sulfur dioxide. Qualitatively, other sulfur dioxide complexes show the same kind of shift, regardless of their mode of bonding. The difference between the two high frequency bands, however, appears to be symptomatic: if the difference is greater than 190/cm, the complex is oxygen bonded; whereas, if the difference is less than 190/cm, the complex is bonded through the sulfur (free sulfur dioxide liquid displays a difference between the two high frequency bands of approximately 190/cm). Author abstract modified)

G. EFFECTS-HUMAN HEALTH

00165

M. Kleinfeld

ACUTE PULMONARY EDEMA OF CHEMICAL ORIGIN. Ind. Hyg. Rev. 7, (2) 1-10, Dec. 1965. (Reprinted from the Arch. Environ. Health 10, 942-6, June 1965.)

Six instances of pulmonary edema due to toxic exposure to ozone, nitrogen dioxide, cadmium oxide fumes, dimethyl sulfate, hydrogen sulfide and hydrogen fluoride are presented. The problems of diagnosis are discussed. In view of the unusual severity of these cases, the following points were stressed: (1) the need of the physician to be aware of the possible industrial origin in all instances where the cause of the pulmonary edema is obscure; (2) the importance of careful observation of the patient known to be exposed to an agent capable of producing a delayed pulmonary edema, even in the initial absence of any symptoms; (3) since certain of these agents, such as ozone and hydrogen sulfide, can act on the central nervous system to produce respiratory depression, it is contraindicated to administer morphine in these instances. Digitalis likewise has no place in the management of pulmonary edema caused by exposure to the chemicals mentioned. The effective treatment is primarily preventive, which calls for proper ventilation of the work environment and an adequate knowledge of the operational processes and procedures. The immediate treatment should include the following: (1) oxygen under controlled positive pressure to the inspiratory cycle, (2) nebulized bronchial dilators for the bronchial spasm, (3) steroids in the more severe cases, (4) broad-spectrum antibiotics for superimposed bacterial infection, (5) nebulized nonirritant bronchial detergents for increasing mucous secretion, and (6) tracheostomy as indicated. (Author)

01047

D. Lester and W. R. Adams

THE INHALATIONAL TOXICITY OF OXYGEN DIFLUORIDE. Am. Ind. Hyg. Assoc. J. 26(6):562-7, Dec. 1965. (Presented at the American Industrial Hygiene Conference, Houston, Tex., May 6, 1965.)

The acute inhalational toxicity of oxygen difluoride in the albino rat has been determined at concentrations of 5 to 40 ppm for 5 to 15 minutes. A CT product (ppm-minutes) of about 100 results in 50% mortality. At the levels studied, gross and microscopic pulmonary damage develop 7 hours after termination of the exposure and if death does not intervene, repair begins after the third day. The extreme toxicity of oxygen difluoride and its insidious character make it imperative to exclude its inhalation by personnel. (Author abstract)

01096

F. N. Dost, D. J. Reed, and C. H. Wang

EXPOSURES OF BIOLOGICAL SYSTEMS TO INORGANIC FLUORIDE OXIDIZING AGENTS. VOLUME I. HANDLING AND EXPOSURE TECHNIQUES. Oregon State Univ., Corvallis, Radiation Center (Rept. No. AMRL-TR-65-223-Vol. I) 25 pp. Dec. 1965. CFSTI,DDC: AD 631 483

A system adaptable for diluting and distributing various inorganic fluoride oxidizing agents has been developed. Known dilutions of these agents in nitrogen or air are generated on the basis of flow rate ratios between undiluted gas and various diluent gases, and confirmed chemically. Problems of materials compatibility, personnel protection, stability of the agents and exposure system design are discussed. (Author abstract)

01338

C. W. Chang and C. R. Thompson

SUBCELLULAR DISTRIBUTION OF FLUORIDE IN NAVEL ORANGE LEAVES. Intern. J. Air Water Pollution (London), Vol. 9:685-691, Nov. 1965.

Navel orange leaves from trees grown in a fluoride contaminated atmosphere were analyzed for intracellular distribution of fluoride. Leaf tissue was homogenized and fractionated by differential centrifugation in sucrose solution. The subcellular distribution of fluoride in particulates was, in decreasing order, cell wall, chloroplast, water soluble protein, and mitochondria. However, when consideration is made of the major cross-contamination of chloroplast and/or chloroplast fragments and protein, the fluoride accumulation was assumed to be, in decreasing order, chloroplast, cell wall, water soluble protein, and mitochondria. Almost 60 per cent of the total fluoride in the homogenate was in the supernatant fraction. Some fluoride was found to be associated with the water soluble protein. Negligible amounts of fluoride were found in organic acids and sugars. (Author abstract)

01426

J. W. Clayton, Jr. D. B. Hood, M. S. Nick, and R. S. Waritz

INHALATION STUDIES ON CHLOROPENTAFLUOROETHANE. Am. Ind. Hyg. Assoc. J., Vol. 27:234-238, June 1966.

Dogs, rats, mice, and rabbits were exposed to an atmosphere of 10% chloropentafluoroethane for 90 exposures of six hours each. Body weight and clinical condition of rodents were unaffected. Rat and dog blood, urine analyses, and urinary fluoride analyses revealed no significant changes. Dog weight gain, temperature, respiration, and pulse were normal. Gross examination, histology, and organ weights of all species revealed no effects attributable to chloropentafluoroethane. An industrial hygiene standard of 1000 ppm as an eight-hour time-weighted average is suggested. (Author abstract)

01674

S.S. Woltz C.D. Leonard

EFFECT OF ATMOSPHERIC FLUORIDES UPON CERTAIN METABOLIC PROCESSES IN VALENCIA ORANGE LEAVES. Proc. Florida State Hort. Soc. 77, 9-15, 1964. (Presented at the Florida State Horticultural Society, Miami, Nov. 3-6, 1964.)

The removal of fluoride from the atmosphere around Valencia orange trees resulted in greater rates of photosynthesis, enhanced chlorophyll contents and lower rates of respiration.

The degree of removal of fluoride was estimated by leaf analysis and by the degree of development of fluoride leaf scorch of gladiolus indicator plants. Preliminary procedures were tested for the removal and measurement of leaf-surface reacted fluorides. Time course measurements were made of the resistance of leaf- surface fluorides to removal by weathering outdoors. It was found that surface reacted fluoride from hydrofluoric acid solution dips remained on the leaves outdoors for nine days. Brief immersion (15 seconds) in dilute hydrofluoric acid solutions resulted in a depression in photosynthesis activity and in a significant closure of stomata. Needs for further research are discussed. (Author summary)

01728

L. Ordin and A. Altman

INHIBITION OF PHOSPHOGLUCOMUTASE ACTIVITY IN OAT COLEOPTILES BY AIR POLLUTANTS. Physiol. Plantarum 18, 790-7, 1965.

A marked inhibition of cellulose and of glucan biosynthesis induced by the air pollutants fluoride, ozone and peroxyacetyl nitrate (PAN) was found in oat coleoptile sections. It was suggested that a common point of attack by these inhibitors might be phosphoglucomutase which catalyzes the interconversion of glucose-6-phosphate and glucose-1-phosphate. Glucose-1-phosphate is a probable precursor for glucan and cellulose biosynthesis. Fluoride is known to inhibit plant phosphoglucomutase in vitro more than the other enzymes involved in sucrose biosynthesis. Photooxidation producing inactivation has been carried out with pure phosphoglucomutase of animal origin. The influence of the air pollutant oxidants both in vivo and in vitro on this enzyme is unknown. The purpose of this report is to present results concerning the effect of these inhibitors on phosphoglucomutase activity in oat coleoptile tissue and the effects on enzyme prepared from this tissue.

01794

V. Pirila, L. Noro, A. Laamanen

AIR POLLUTION AND ALLERGY. Acta Allergol. (Copenhagen) 18, 113-30, 1963

After describing some examples of acute air pollution episodes, the authors give a brief review of natural air pollution from the allergological point of view. Cultural air pollution is considered under two headings: indoor or local, and outdoor or general. The capacity of some chemical present in outdoor air-SO2, H2S, NH3, Be and F-to provoke allergic diseases is discussed on the basis of the literature and personal investigations. Finally some figures and examples are given regarding the quality and degree of air pollution in the USA and in Finland. The authors stress the difficulty which arieses in fixing the maximum allowable concentrations for general air pollution, owing to the wide variations in physiological response in general and in allergic reactivity in particular. (Author summary modified)

02539

(INHALED NOXIOUS POLLUTANTS.) Pollutants nocifs inhales. (Part of Chapter 1: Les pollutions et 'nuisances d'origine industrielle et urbaine. Tome 1. Leur prevention et les problemes scientifiques et techniques qu'elle pose en France.) Premier Ministre, Delegation generale a la recherche scientifique et technique. 13-7, June 1966.

This information on inhaled noxious pollutants, which is presented in brief semi-outline form, deals with: chronic and acute effects, influence of dusts on the lungs, influence of non-carcinogenic pollutants, influence of bacteria and viruses, and principal areas of concern in research. Pollutants must be considered both for their independent effect and for that which is conditioned by the state of health of the person such as that of persons with cardiovascular impairment or chronic bronchitis. Reactions from a number of pollutants, including ozone, nitrous vapors, and carbon monoxide, are of great concern. Research studies are being pursued with synthetic atmospheres in relation to synergistic actions; with studies of the atmosphere in certain areas of Paris during a normal period and during a period of smog; with toxicological studies of certain chemical agents, particularly sulfur dioxide, carbon monoxide, and various fluorine compounds, with a view of fixing their limits of tolerance; with the carcinogenic potential of chemical agents as pollutants; and with consideration of the respiratory tree as influenced by inhaled chemical agents and studies of respiratory insufficiencies. This information is given in a section of Chapter 1 of this monograph.

03246

Y. Yoshida

EXPERIMENTAL STUDIES ON CHRONIC FLUORINE POISONING. Effects of a Small Amount of Fluorine on a Living Body. Japan. J. Ind. Health (Tokyo) 1, (7-8) 683-90, Nov. 1959. Text in Japanese.

The following experiment is described: in 4 groups of rabbits, sodium fluoride (0.017, and 1.67 mg (kg body weight) was administered orally for 20 months. There were no striking changes in body weight, the blood picture, or the ECG. Mottled teeth and abrasion of the incisors were noted after 7 months. Symptoms of bone hardening such as swelling of the epithelium, increase of diameter, and increase in bending were observed. Swelling, turbidity, and vacuolation in liver and kidney, cells and slight myocardial fiber atrophy were observed, depending on the amount of fluorine administered. Pathohistological degeneration of the liver, kidney, heart, and spleen could be noted in the offspring of treated rabbits.

03394

E.J. Catcott

EFFECTS OF AIR POLLUTION ON ANIMALS. World Health Organ. Monograph Ser. 46 (Air Pollution), 1961. pp. 221-31.

The report of animal morbidity and mortality which followed major air pollution episodes would be regarded critically. The investigations of these acute and intense exposures to air pollution have been done retrospectively. It is significant that the owners' reports of injury to animals could not be corroborated by professional observers at the Donora disaster. The high rate of animal mortality which allegedly occurred at Poza Rica is generally in contradiction to the information concerning the relative susceptibility to air pollutants of animal species which have been studied experimentally. The synergistic roles of physiological and of external environmental influences on reactions to air pollution indicate that the interactions of many factors may be necessary to produce critical situations. In contrast to the paucity of information concerning natural exposure to most air- borne pollutants, the effects of fluorides on animals have been defined well. Laboratory research has provided important information concerning the effects of specific pollutants on animals. Mice, rabbits, guinea-pigs, rats and monkeys have been utilized to demonstrate the toxic properties of such air pollutants as sulfur dioxide, sulfuric acid, hydrogen sulfide, ozone, nitrogen dioxide, organic compounds, and some dusts. Information which has been obtained by artifiicial exposure of animals is providing some indices of both human and animal effects to be expected from natural expo-

sures. A well-integrated attack, in the field and in the laboratory, will be necessary to divulge the true details of the biological effects of polluted air. (Author summary modified)

04145

S. Akashi

THE MECHANISM PRODUCING METAL FEVER IN THE PROCESS OF WELDING WITH LOW HYDROGEN-TYPE ELECTRODES. Japan J. Ind. Health (Tokyo) 3, (4) 237-48, Apr. 1967. Jap.

The causes of metal fume fever might be attributed to the high emission of MgO particles in the dusts from the low-hydrogen type electrodes during the welding process. Using 4 types of electrodes including low-hydrogen type electrodes, the mineralogical composition of coating materials was determined by microscopical examinations. CaF2, ferrosilicon, a large amount of CaCO3, MgCO3 (in the form of dolomite), and water glass were found. After experimental welding was performed with different electrodes, one evidence of melting was found at the end of low-hydrogen type electrodes, while the end of another type showed the evidence of melting by the heat of the arc. By the thermobalance method the author measured the change in weight during continuous heating and examined the time-weight loss curve at different firing temperatures. The heating curves of the low-hydrogen type electrodes show a maximum decrease of weight at 600 C (as a result of the decomposition of carbonates), a marked increase of weight (as a result of oxidation) by heating above 600 C, the definite loss of weight as a result of a high porosity above 800 C, and a high sensitivity to the sudden change of temperature. Definite heat absorption at 500 C and 750 C and heat evolution at 600 C were observed in the differential thermal analysis of the low-hydrogen type electrodes, properties which are important as a cause of rapid destruction of the material. It was found that the porosity of the fired material after heating above 800 C shows a marked decrease in the number of MgCO3 particles, signs of dehydration of the water glass, and production of new round crystalline formations from the ferrosilicon particles which had originally irregular contours. (Author summary modified)

04734

K. Koshi, H. Hayashi, A. Hamada, and H. Sakabe

THE TOXIC EFFECT OF THE VARIOUS DUSTS ON THE INTRAPERITONEAL MONOCYTE IN RAT. Bull. Natl. Inst. Ind. Health (Kawasaki, Japan) 6, 10-27, 1961.

The toxic effect of various mineral dusts on the monocyte of the rat is described. In a study of the effect of particle size on cell toxicity, it was assumed that the toxicity was indicated by the inhibition of the dehydrogenase activity of the cultured monocytes. The cell toxicity increased with the decrease of particle size in leached quartz, but it did not correlate in such a manner in particle sizes under 2 microns in original quartz or sericite. In a study of toxic doses to the monocytes of various mineral dusts based on the tetrazolium reducing capacity, the doxicities of the dusts decreased in the following order: (1) Tridymite; (2) NaOH leached quartz, quartz ground by hand for 2 min, fused silica, and cristobalite; (3) Serecite (Hitachi); (4) Opal, pyrophyllite, talc, sericite (Yoji), and Kibushi-clay; (5) Topaz, fluorite, tourmaline, cyanite, diatomaceous earth, serecite (Nasu), halloysite and sphalerite; (6) Olivine and asbestos; and (7) Microcline chlorite, diposide, obsidian, albite beryl, pyrite, muscovite, and anthracite.

04849

R. A. Call, D. A. Greenwood, W. H. LeCheminant, J. L. Shupe, H. M. Nielsen, L. E. Olson, R. E. Lamborn, F. L. Mangelson, and R. V. Davis

HISTOLOGICAL AND CHEMICAL STUDIES IN MAN ON EFFECTS OF FLUORIDE. Public Health Rept. 80, (6) 529-38, June 1965.

In this investigation, 127 human bodies were autopsied and studied for gross, histological, and chemical evidence of fluoride intoxication. Eighty-eight of these deceased persons came from geographic areas known to have had a elevated fluoride levels in the atmosphere and forage. Analyses for fluoride, calcium, phosphorus, and ash were made on the calvarium, sternum, rib, iliac crest, and lumbar vertebrae. Determinations for fluoride and dry matter were made on the brain, heart, lungs, thyroid, aorta, liver spleen, pancreas, and kidney. The highest fluoride levels were observed in older adults showing the end-stage kidney of bilateral pyelonephritis and polycystic disease. Average levels were found in subjects with unilateral pyelonephritis and in subjects with pyelonephritis with only slight to moderate disease. The highest fluoride levels found, in subjects with the most severe kidney disease, were within the normal range, and no disease associated with fluorides was evident. Because the number of cases of chronic renal disease in this series was limited, further studies seem advisable. (Author summary)

04927

R. A. Abbanat and R. P. Smith

THE INFLUENCE OF METHEMOGLOBINEMIA ON THE LETHALITY OF SOME TOXIC ANIONS. I. Azide. Toxicol. Appl. Pharmacol. 6, (5) 576-83, Sept. 1964.

The time course and extent of the methemoglobinemia induced by intraperitoneal sodium nitrite and p-aminopropiophenone (PAPP) have been characterized in female mice. The peak methemoglobin formation (34%) from sodium nitrite (75 mg/kg) is achieved in about 40 minutes. Comparable levels from PAPP (15 mg/kg) are achieved more quickly (between 5 and 10 minutes) but decline more rapidly to normal. Both nitrite- and PAPP-induced methemoglobinemia afford a significant degree of protection against poisoning by sodium azide when administered in an appropriate time sequence. It was not possible under the same circumstances to protect mice against death from fluoride, cyanate, thiocyanate, selenate, or borate, although some prolongation of survival time was seen after fluoride. The formation of the azidemethemoglobin complex has been demonstrated within intact mouse red blood cells, and small amounts of the complex were identified in vivo in an antidotal situation. It is considered important that the protective action of methemoglobinemia has been demonstrated to date only against established inhibitors of cytochrome oxidase. (Author summary)

04983

E. J. Largent

EFFECTS OF FLUORIDES ON MAN AND ANIMALS. Proc. Natl. Air Pollution Symp., 1st, Pasadena, Calif., 1949. pp. 129-34.

Chronic fluorosis in livestock is the effect most frequently associated with the release of fluorides into the general atmosphere. A herd of cows, ranging in age from five to thirteen years, was examined on a farm adjacent to a factory in which rock phosphate was being processed. The length of time during which the cows had been pastured near this factory ranged from five to nine years. Most of the animals displayed symp-

toms of chronic fluorosis. Analysis of tissues obtained from three of the affected cows indicates that the animals had considerable exposure to fluorides. Samples of elm leaves contained fluoride to the extent of nearly 7,000 ppm and samples of grass approximately 300 ppm. In a few instances samples of air collected on the farm had remarkably high fluoride concentrations. The gaseous portions of the samples always contained far less than 1 ppm, while the concentrations of particulate fluorides were sometimes much higher than the gaseous component, a factor which was important in the production of fluorosis. Information as the effects of human exposure to fluorides is separated on the basis of its relationship to the acute effects, and the chronic effects. The metabolic fluoride balance of an experimental subject during periods of normal and elevated intake are tabulated. It is concluded that the pollution of the atmosphere with fluorides, as the result of industrial operations, may contaminate near-by vegetation and induce chronic fluorosis among cattle grazing thereon. However, it seems unlikely that any human discomfort or impairment of human health will occur from present normal industrial operations.

05504

R. J. Conroy

THE EFFECTS OF AIR POLLUTION ON VEGETATION. Proc. Clean Air Conf., Univ. New South Wales, Vol. 1, 22p., 1962, Paper 8.

Solid, liquid and gaseous pollutants are present in the atmosphere. Ash, grit and tars in smoke form mechanical barriers to the maximum use of solar energy by the plant. Dusts from chemical manufacture interfere with the plant's physiological processes and acid aerosols cause leaf spotting. Coal combustion releases sulphur dioxide and various industrial processes release gaseous fluorides. Extensive injury has resulted from the continuous emission of these gases in agricul- turan and pine forest areas. Other gaseous pollutants have beenof less importance on a large scale. Sulphur dioxide is toxic to sensitive plants in parts per million of air and flourides are toxic in part per thousand million. Plants vary widely in their sensitivity to either sulphur dioxide or fluorides and in their relative sensitivity to both gases. Environmental factors have a marked effect on sensitivity. Studies of meteorological data, air analyses, plant analysis and of the reaction of indicator plants have been of value in the determination of gaseous pollutant damage. A mathematical formula for the objective assessment of sulphur dioxide damage has been derived and losses in some crops have been calculated. Mathematical assessment of fluoride damage has not yet been possible. Any assessment of crop damage by air pollutants must call for a parallel evaluation of the reductions in yield which would result from unfavourable environmental influences, e.g. weather damage, from toxic materials in the soil, from nutrient deficiencies and from the depredations of insect pests or plant damage diseases. (Author abstract)

05833

Goldsmith, John R.

AIR CONSERVATION - THE BIOLOGIST S VIEW. Preprint, American Assoc. for the Advancement of Science, 13p., 1963. (Presented at the American Association for the Advancement of Science Meeting, Cleveland, Ohio, Dec. 29, 1963.)

The effects of air pollution on the biosphere are reviewed in terms of the necessity for establishing a strategy of air conservation. Topics covered include: air pollution episodes associated with increased morbidity and mortality rates; epidemiologic studies investigating the association between air pollution and increased rates of respiratory disease and cancer; physiologic tests designed to determine the effects of sulfur dioxide and carbon monoxide on experimental animals and human volunteers; the irritating effects of irradiated motor vehicle exhaust on the respiratory tract and eye; the action of ozone as an irritant and phytotoxicant; the effects of photochemical oxidants and fluorides on vegetation and animals feeding off of such vegetation; and the necessity for air conservation plans which take into account the air shed and dilution capacity of the environment.

06288

T. R. Carson and F. T. Wilinski

ACUTE INHALATION TOXICITY OF TETRAFLUOROHYDRAZINE. (Army Chemical Research and Development Labs., Edgewood Arsenal, Md., Toxicology Division.) (May 1963). 15 pp. (Rept. No. CRDLR 3174.)

Experiments were designed to study the effects of tetrafluorohydrazine resulting from single, short-exposure periods. Rats were exposed to various concentrations of N2F4 for single 15-,60-, and 240-min periods, and the LC50'S were calculated. A 60-min LC50 for guinea pigs was also determined. In addition, rats and dogs were exposed to several concentrations below the 15- and 60-min rat LC50's. The criteria used to evaluate the toxicity of N2F4 were eye and nasal irritation, cyanosis, and hematologic and pathologic changes. Pathologic changes were the least effective measure for determining the toxicity of N2F4 in the short exposures. The other signs decreased in severity as the concentration was lowered. Rats showed signs of eye and nasal irritation at concentrations causing no such effects in dogs. At these concentrations, however, dogs had a greater increase in methemoglobin than did the rats. Based on the responses of rats and dogs, the threshold concentrations for the production of toxic effects were about 500 and 100 ppm of N2F4 for 15 and 60 min, respectively. (Author abstract)

06485

FLUORIDE-BEARING DUSTS AND FUMES (INORGANIC). Am. Ind. Hyg. Assoc. J. 26 (4), 426-30 (Aug. 1965).

Guidelines for industrial health considerations and procedures for those exposed to fluoride-bearing dusts and fumes (inorganic) are set forth. In general, these compounds are more neutral in comparison to gaseous and liquid fluoride compounds and all are soluble in inorganic acids. They may decompose and react with other compounds to give off HF and other irritating compounds. Hygienic Standards: (1) Recommended Maximal Atmospheric Concentrations (8 hrs): 2.5 mg (F ion)/cu m of air; (2) Short exposures may vary widely, the more soluble fluoride forms being the more toxic. Toxic Properties: (1) Inhalation - repeated exposures to excessive concentrations of fluorides in the air over a long period of time result in increased radiographic density of the bones and may be responsible for anatomical abnormalities; (2) Skin Contact - this may cause rash; Eye Contact - exposures to neutral dusts and fumes have not been considered serious; Ingestion: acute fluoride intoxication may result from ingestion of soluble flucrides, like NaF in amounts as low as 500 mg; chronic fluoride intoxication or fluorosis may result from daily intake of excessive amounts of fluoride over long periods of time. Evaluation of exposures: (1) Air sampling and analysis: A systematic air sampling program should be carried on to ascertain that the average concentration of fluorides in the air does not exceed recommended levels. (2) Biological sampling and analysis: A systematic program of urine analysis should be

conducted for personnel exposed to fluorides; (3) Water sampling: The standard method of the American Society for Testing and Materials and the method listed in Standard Methods for the Examination of Water and Wastewater Including Bottom Sediments and Sludges are recommended. (4) Hazards and their Recommended Control: The principal problem from industrial exposures to the fluorides other than the highly corrosive forms is fluorosis caused by inhalation or ingestion.

06497

O. M. Derryberry, M. D. Bartholomew, and R. B. L. Fleming

FLUORIDE EXPOSURE AND WORKER HEALTH (THE HEALTH STATUS OF WORKERS IN A FERTILIZER MANUFACTURING PLANT IN RELATION TO FLUORIDE EXPOSURE). Arch. Environ. Health 6(4), 503-11 (Apr. 1963).

Clinical and laboratory studies were conducted to assess the health of a group of workers exposed to fluorides as compared with a group of workers equivalent in age, race, and living standards without industrial exposure to fluorides. No disability attributed to fluoride exposure was encountered in any of the individuals in this study. Minimal or questionable degrees of increased bone density were found in 23% of the fluoride-exposed group. Abnormal findings related to the gastrointestinal and cardiovascular systems occurred in the two groups with approximately equal frequency. The distribution of findings suggestive of not-normal genitourinary conditions was approximately the same for the fluoride-exposed group and the control group except for the incidence of albuminuria which was found to be higher in the exposed group. This finding and its distribution in the sub-groups suggest the possibility of a relationship between fluoride exposure and increased excretion of albumin in the urine. The fluoride excretion level of 4 mg. of fluoride per liter in urine samples collected at the end of the work shift has been found to serve as a useful reference level for evaluating atmospheric fluoride exposure where industrial environmental concentrations vary widely and in determining the probability of incurring increased bone density. (Author summary modified)

06675

Z. Ya. Lindberg

EFFECT OF SUPERPHOSPHATE PRODUCTION DISCHARGES ON CHILDREN'S HEALTH . U.S.S.R. Literature on Air Pollution and Related Occupational Diseases, Vol. 7, 284-8, 1962. (Gigiena i Sanit.,) 25 (5), 89-96 (1960). Russ. (Tr.) CFSTI: 62-11103

In order to assess the possible health effects of emissions from a superphosphate plant, the frequency of upper respiratory illness was studied in 2053 children. Of this total, 1375 children lived in the vicinity of the plant and 678 were controls. Air samples were taken in the inhabited zones around the plant at distances of 500 and 3000 meters. The concentrations in excess of allowable limits are given for SO2, H2SO4, F, and NOx. Most of the children involved in the study were given either x-ray or fluoroscopic chest examinations. The results of these examinations were correlated with tuberculin skin tests. The data indicated that children residing in the area of the superphosphate plant had a higher frequency of both upper respiratory ailments and tuberculosis.

07013

DeVilliers, A. J., and P. Gross

THE PULMONARY RESPONSE OF RATS TO FLUORSPAR DUST AND RADIATION. Proc. Intern. Symp. Inhaled Particles Vapours, II, Cambridge, England, 1965. p. 135-140, 1967.

An attempt was made to study separately the biological effects of fluorspar and radiation and the possible effect of radiation per se on the clearance of dust from the pulmonary tissues. Dust was, injected six weeks after irradiation (external radiation). This time interval was determined by a pilot study and coincided with a maximum early recovery from acute radiation injury. In these experiments, calcium fluoride (fluorspar) injected intratracheally in adequate dosage caused no significant pulmonary fibrosis and behaved as a so-called inert dust. X-irradiation of the chest in rats at the dosages used in this investigation produced relatively slight collagenization of alveolar walls, several mouse-type adenomata and an adenocarcinoma within one year following irradiation. No inhibition of alveolar clearance was observed when lung dust burden was imposed six weeks following the irradiation. The failure of the X-irradiation to affect the alveolar clearance mechanism is attributed to the timing of the dust-burden imposition, a time when the alveolar lining had recovered from the radiation effects. A greater degree of alveolar fibrosis in the radiation-plus-dust animals than in the other groups was observed. Additive or adjuvant factors require further study. A high incidence of endemic chronic broncho-pulmonary disease was observed among dusted animals whereas none was found in stock controls or in animals exposed to radiation only.

07098

Noro, L., V. Pirila, and A. Laamanen

AIR POLLUTION AND ALLERGY. (Work Environ. Health (Helsinki),) Vol. 1, p. 2-15, Oct. 1962.

The authors current knowledge regarding the problem of air pollution and allergy is reviewed and observations made in Finland are presented. Air pollution is divided into natural and cultural the former deriving from wind pollinated plants and the latter from industrial sources. Emphasis is on cultural pollution and major pollutants such as SO2, beryllium, and fluorine are treated individually. It is pointed out that there is a disparity between maximum allowable concentrations, as commonly set, and concentrations tolerated by allergic individuals.

07344

J. Migueres, M. Layssol, G. Moreau, A. Jover J. Tricoire

PULMONARY SCLERODERMA AND ASSOCIATED FLUOR SPAR SILICOSIS- RELATION BETWEEN SCLERODERMA AND SILICOSIS. ((Sclerodermie Pulmonaire et Silicose du Spath Fluor Associee Rapports Entre Sclerodermie et Silicose.)) Text in French. J. Franc. Med. Chir. Thorac. (Paris), 20(6):603-618, Sept.-Oct. 1966. 43 refs.

A case is reported of a fluor spar miner in whom was found scleroderma of the sclerodactylic type with subacute myositis, complex endocrine disorders, gynecomastia, and dysoric retinopathy. A pulmonary biopsy showed sclerodermic diffuse interstitial fibrosis and nodular silicotic lesions. Photomicrographs are shown of muscular, skin, and pulmonary biopsy specimens as well as chest plates. There are anumber of problems associated with this case such as the effects of the fluor spar on the lung, the pulmonary effects of schleroderma, and the association of scleroderma and silicosis. Recent statistics show that the association is not unvommon, but as yet no specific anatomic or radiological characteristics have been determined. The incidence of scleroderma in miners s high and the question of pathogenic relation between scleroderma and pneumoconiosis has not been answered.

07917

Keplinger, M. L.

FLUORINE TOXICITY STUDIES. Miami Univ., Fla., School of Medicine, Grant NASA-NGR-10-007-012, 14p., b8dec. 1, 1966. (Status Progress Report.) NASA: N67-28013

Studies to determine the toxic effects of fluorine are being continued. The results summarized in this report generally are preliminary. The concentrations which cause irritation in man were determined. When rats and mice survive for six months after exposures which damage the kidneys, regeneration of the tissue is essentially complete. Repeated, intermittent exposures to fluorine appeared to cause lesser effects than a single exposure at the same concentration. Animals exposed to low concentrations of fluorine appear to be less susceptible to the effects caused by exposure to high concentrations of fluorine than animals which have not been exposed previously. The formation of edema following exposure to fluorine was shown. Succinic dehydrogenase may be increased in the lung after inhalation of fluorine. Very young and rather old mice apparently are no more susceptible to fluorine than the young adult animal. (Author's summary)

07961

DeVilliers, A. J.

CANCER OF THE LUNG IN A GROUP OF FLUORSPAR MINERS. Can. Cancer Conf. (Ontario), Vol. 6, p. 460-474, 1964. 13 refs.

A study of the community of St. Lawrence, Newfoundland including the entire physical environment of the people was undertaken because of the statistically significant number of deaths due to lung cancer and tuberculosis. All of the deaths due to lung cancer involved individuals who were born in St. Lawrence and who had worked in the fluorspar mining industry at some period. An analysis of underground dust samples from the mines showed concentrations of SiO2 and CaF2 which, though high, were not considered alarming. The unusual factor proved to be radon daughters in the atmosphere, from the mine ground water. Ventilation was installed in the mines. Ratios of actual fatalities to statistically expectable mortalities for the area gave figures in a range of 12.56-146.34. The increasing incidence with increasing duration of underground exposure indicated an occupational hazard. Smoking was also mentioned as a contributing factor but heredity was inconclusive. Tuberculosis and malignancies of the buccal system and digestive system were also found with increased exposure. Full statistics on atmospheric findings and tables of death statistics for the population of the mines are included.

08030

Reed, Donald J., Frank N. Dost, and Chih H. Wang

EXPOSURES OF BIOLOGICAL SYSTEMS TO INORGANIC FLUORIDE OXIDIZING AGENTS. VOLUME II. FLUORIDE ANALYSIS BY CHEMICAL METHODS. Oregon State Univ., Corvallis, Radiation Center, Contract AF 33 (615) - 1799, Proj. 6302, Task 630202, AMRL-TR-65223-Vol II, 20p., Dec. 1965. 19 refs. CFSTI, DDC: AD 630593

Methods are described for assaying the fluoride content of ashed samples of plant and animal tissues. Using the Hall method submicrogram quantities of fluoride were measured and a new procedure was devised to measure fluoride in a 1 to 8 microgram range. Modification of the Weinstein procedure, in which an AutoAnalyzer is used, permitted rapid and semiautomated analysis samples containing 2.5 to 100 micrograms of fluoride. (Authors' abstract)

08031

M. L. Keplinger

FLUORINE TOXICITY STUDIES AT THE UNIVERSITY OF MIAMI. (SEMI-ANNUAL PROGRESS REPORT.) Miami Univ., Fla., Research and Teaching Center of Toxicology, Grant NGR-10-008-012, CR-69992, 6p., Nov. 308 1965. CFSTI: N68-18861

Animals were exposed to fluorine in a specially developed exposure chamber. Signs of intoxication from high concentrations of fluorine in air were marked irritation of the mucous membranes of the eyes and respiratory tract. The skin of the animals showed very little irritation at the concentrations used. The LC50 (concentration calculated to kill 50% of the animals) was determined for 5, 15, 30 and 60 minutes of exposure in both rats and mice. The LC50 for guinea pigs was determined for 15 and 60 minutes of exposure, while the LC50 in rabbits was determined after 5 and 30 minutes of exposure. There appeared to be very little difference between the LC50's of the different species. At lower concentrations there were fewer signs of intoxication. Dyspnea, lethargy, red nose and swollen eyes were observed at concentrations equivalent to 50% of the LC50's. At concentrations which were 25% of the LC50's there were only mild signs of intoxication, manifested by slight dyspnea and closed eyes. At lower concentrations there were no gross signs of intoxication. Complete blood counts of these animals showed no significant changes, however it is interesting that the clotting time appeared to be affected. Although this phenomenon was not tested (but probably should be) the blood did not seem to clot as rapidly as normal. Gross pathology found in animals, which succumbed from exposure or were sacrificed following exposure near the LC50's, was congestion, hemorrhage and atelectasis in the lungs and some congestion and/or mottling in the liver. Survivors which were sacrificed up to 45 days after such exposures had congestion in the lungs and occasional congestion in the liver. There was some discoloration of the kidneys in animals which were sacrificed 8 to 14 days after exposure. This appeared to be more prevalent in mice than in other animals. Gross changes in the lungs were found after sacrifice of animals which showed no signs of intoxication. The information ot date indicates that concentrations of about 10 to 15% of the LC50's cause little or no gross pathology in the lungs.

08201

Demidenko, N. M.

THE EFFECT OF MIXED INDUSTRIAL DUST ON THE ORGANISM.Gigiena i Sanit., No. 11:26-29, 1954. 13 refs. Translated from Russian by B. S. Levine, U. S. S. R. Literature on Air Pollution and Related Occupational Diseases, Vol. 4, p. 243-247, Aug. 1960. CFSTI: TT 60-21913

Knowledge of the combined action of mixed dust is essential for the determination of hygienic limits of allowable dust concentration in the air, and for the rational selection of means for the protection of sanitary working conditions in mixed dust generating industries. Mixed dust containing quartz and hematite (ferric oxide), quartz and fluorite, quartz and coal, and quartz and chalk were investigated. Chalk dust used as bulk material in the preparation of mixed dust samples of uniform compnent ratios. Each dust mixture consisted of 50 percent quartz and 50 percent admixture. The dust mixtures were introduced intratracheally in 4 series of tests using white rats. Animals were kept under observation 6 - 8 months then sacrificed and their internal organs were fixed in 10 percent formalin. It was shown that: a) dust mixtures containing 50 percent silicon dioxide and 50 percent coal or hematite had a less pronounced pathogenic effect than the same percentage of silicon dioxide alone; b) fluorite admixture did not lower the effect of silicon dioxide but changed its character; this may be

regarded as due to an added increase in pathogenic effect of such a mixture of dusts. Differences in the chemical nature of the dust components may necessitate a change in the limit of allowable dust concentration arrived at on the basis of the primary component alone.

08702

Lewis, Charles E., and G. R. Kerby

AN EPIDEMIC OF POLYMER-FUME FEVER. J. Am. Med. Assoc., 191(5): 103-106, Feb. 1, 1965. 18 refs.

An 'epidemic' of Polymer-fume fever involved 36 of 61 employees in one industry over a 90-day period. All of those involved demon strated the classic history of an influenza-like syndrome, with fever and chills occuring several hours after exposure to the pro- ducts of pyrolysis of polytetrafluoroeothylene (Teflon). The majority of cases resulted from this material. A study of pulmon- ary function of all workers involved demonstrated changes that could be accounted for only on the basis of smoking habits. Three persons experienced changes in pulmonary function sonsistant with mild obstruction of airways, in association with the onset of symptoms. While no serious consequneces were observed, the effect of these illnesses upon the health and productivity of the group could have been prevented. (Author Abstract)

09575

Singer, Leon and W. D. Armstrong

DETERMINATION OF FLUORIDE IN BONE WITH THE FLUORIDE ELECTRODE. Anal. Chem. (U.S.), 40(3):613-614, March 1968. 8 refs.

Electrodes made from single-crystal sections of rare earth fluoride have been developed to measure fluoride ion activity in solution. A simple direct method for determination of fluoride in bone with the use of a fluoride ion electrode and a conventional potassium chloride electrode is rapid and accurate. Factors such as pH, ionic strength, temperature, and some other ions must be rigorously controlled in both standard and unknown solutions to obtain meaningful results. The method is applicable also to fluoride in the ash of other normal and pathological calcifications.

10203

Balazova, G., L. Balazovjechova, and V. Kirilcukova

DEPTH ANALYSIS OF THE HEALTH OF CHILDREN LIVING IN THE VICINITY OF ALUMINUM WORKS. (Hlbkovy rozbor zdravotneho stavu deti v sidlis- kac z okolia zavodu na vyrobu hlinika.) Translated from Slovak. Cesk. Hyg., 5(10):573-579, 1960. 20 refs.

Children living in a village in the vicinity of an aluminum plant and in a control village were examined for hemoglobin percentage, erythrocyte and leucocyte counts, differentiation of the blood coun amount of fluorides eliminated in urine, and general state of healt In the case of the children of the affected village radiographs we also taken of the bones, and the children's teeth were examined. I the affected village the average percentage of hemoglobin was 62.85 in the 6-8-year-old group and 69.55 in the 9-11-year-old group as compared to 70.95 and 72.25 respectively in the control village. T average erythrocyte count in children of the affected village was 3,958,000 in the 6-8-year- old group and 4,208,000 in the 9-11-year old group as compared to 3,741,000 and 3,783,000 respectively in th control village. No substantial differences were found in the valu of segmented and unsegmented neutrophiles, eosinophiles, basophiles and the lymphocyte and monocyte counts between children of the affected village and the control village. The average level of fluorides eliminated in urine was 0.91 mg/l in children of the affected village as compared to 0.48 mg/l in those of the control village. Evaluation of subjective complaints and objective symptom shows no perceptible differences between children of the affected village and those of the control village. Radiographs of bones for children of the affected village showed no changes which could be suggestive of pathological and significant fluorosis. The teeth of the children from the affected village also showed no traces of fluorisis as yet. (Authors' summary)

10247

Ivanov, A. E. and K. I. Gorel'chik

BEHAVIOUR OF RADIOACTIVE CERIUM FLOURIDE (144 Ce F3) IN THE LUNGS INTRODUCED INTRATRACHEALLY ((Povedenie v legkikh radioaktivnogo ftoristogo tserija (144 Ce F3) pri vrutritrakheal'nom vvedemi.)) Text in Russian. Med. Radiol. (Moscow), 5(7):65-69, 1965. 10 refs.

A colloidal solution of cerium fluoride (144 Ce F3) was introduced into the trachea of 60 chinchilla rabbits. Each rabbit, weighing about 3 kg, was administered 0.5 ml of solution trascutaneously. The solution had a radioactivity of 25 mc (specific radioactivity 50 mc/ml). Scanograms of the lungs were taken 15 minutes after the introduction of cerium and 4, 8, 16, 32, 60, 120 and 420 days later. Autopsies were performed at intervals and pathological and radiometric tests were made. Scanograms show that the substance gradually concentrates in the periradical zone of the lungs, with two phases of redistribution and elimination. During the 30-day, initial phase, biological lung clearing processes prevailed, while during the second phase, a certain balance between the elimination of Ce144 from the lungs and its radioactive decay was established.

10333

M. C. Sadilova, K. P. Seliankina O. K. Shturkina

EXPERIMENTAL EVALUATION OF CONCENTRATIONS OF HYDROGEN FLUORIDE DETECTED IN THE AMBIENT AIR. ((Zksperimentalnaya otsenka kontsentratsii ftorictogo vodoroda, obnaruzhivaemkh v atmosfernom vozdukhe.)) Text in Russian. Vrachebnoe Delo No. 1:89-91, Jan. 1967. 4 refs.

The aluminum, cryolite, superphosphate and other industries which use fluorine compounds all emit NF, NaF, AIF3, and Na3AIF6 into the air. Air containing fluroine levels of 0.20, 0.10 or even 0.03 mg/cu m has a noxious effect, particularly on children, and raises their general susceptibility to illnesses, attacks their breathing system, and destroys tooth enamel. White male mice, two months old, were exposed to different levels of hydrogen fluoride around the clock for five months, except for a four-week recess. Concentrations of the 0.10, 0.03 and 0.01 mg/cu m level were administered to three groups of animals. The 0.10 concentration was found to produce a profound, generally toxic, effect. Less intense but still clearly defined, were damages caused by the 0.03 concentration. The 0.01 concentration had no detrimental effect. Data from these experiments are thought to be conclusive as to the dangers to children who reside within industrial pollution zones.

10362

Tuma, J.

ELIMINATION OF SILICA DUST FROM THE LUNGS OF RATS AND THE EFFECT OF AEROSOL INHALATION. (Eliminace kremenncho prachu z plic krys a jeji ovlivneni aerosolovymi inhalacemi.) Text in Czechoslovakian. Pracovni Lekar. (Prague), 15(8):334-338, Oct. 1963. 11 refs.

White male rats were exposed in rotating drums to dust containing 96.14% SiO2 and 1.05% A1203 (particle size: 82% under 1.25 micron. Two groups were then exposed six times a week for 30 min. to aerosol inhalations containing either 10 ml CaC12 and 10 ml mineral water ('Vincentka'), or 8 ml solution containing 1 g NaF 6g A12(SO4)3.6H20 and 1 ml concentrated acetic acid. The natural elimination of dust within one month amounted to 63-68% by weight of the dust. The inhalation of the CaC12 mineral water solution had no noticeable effect. The inhalation of the solution containing NaF, however, aggravated the condition and reduced elimination by about 50%.

10842

Grieser, N.

FLUORINE INTAKE INCREASED IN MAN BY FOOD PRODUCTS OF ANIMAL ORIGIN. Med. Ernaehr., 6(2):30-35, 1965. 29 refs. Translated from German by H. Warfield. National Institutes of Health, Bethesda, Md., Translating Unit, 16p., 1965.

The metabolism of fluorine is reviewed, including the tolerance of the human organism for this element. Resorption, tissue accumulation, elimination, and the pathogenetic mmechanism of fluorine are included. Since fluorine-containing mineral phosphates are added to the feed given farm animals, consideration is given to whether its long-range administration can increase the fluorine concentrations of such foods as meat, milk, and eggs. Even when the fluorine doses given the animals are chronically toxic, fluorine supplements are found to be harmless to man. Toxic tolerances are mentioned.

11000

Robinson, Farrel R., Fenton Schaffner, and Esther Trachtenberg

ULTRASTRUCTURE OF THE LUNGS OF DOGS EXPOSED TO BERYLLIUM-CONTAINING DUSTS. Arch. Environ. Health, 17(2):193-203, Aug. 1968.

Two beagle dogs were exposed by the natural respiratory route to rocket exhaust fumes containing beryllium oxide, beryllium fluoride, and beryllium chloride. The lung tissue was examined electron microscopically after a three-year post-exposure period. Beryllium particles and small agglomerates less than 1 micron in size were deposited in lysosomes in the cytoplasm of histiocytes in the interstitium of the septa. They were closely associated with collagen bundles several microns wide and with increases in numbers of septal capillaries. The lesions were more typical of the classical reaction to a foreign-body than immunologic in character and represented an early form of chronic beryllium disease. (Aughors' abstract)

11444

Antoncdli, G.

EFFECTS OF FLUORINE IN THE REGIONS CLOSE TO THE INDUSTRIES THAT PRODUCE IT AND ITS TOXICITY IN PROPHYLACTIC AND THERAPEUTIC USES. ((Effetti del fluoro nelle regioni prossime ad industrie die sua produzione e tossicita di esso anche negli usi profilattici e terapeutici.)) Translated from Italian. Rass. Trimestrale di Odoontoiatria, 35(2):05-122, April-June 1954. 7 refs.

The effects of fluorine compounds on vegetation, cattle, workmen, and students in the vicinity of a fluorine processing plant were investigated. The techniques and methods used at the plant are described indicating the sources of emission. The entire vegetation found in the surrounding territory-plants and trees-were struck and damaged by the toxic gases. Varying degrees of serious effects and certain evidence of pathological disorders were observed - ranging from types of chlorosis to complete dryness due to a third degree scorching. The crop most affected was Indian corn. Cattle showed signs of organic decline with symptoms of anemia of a chronic character and irritation of the bronchial mucosae and of the main respiratory tracts. None of the workers examined displayed signs of fluorosis. The front teeth of the workers and part of the premolars display, dark yellow-green stains. In approximately one-half of the cases the gingival mucosae showed whitish, opaque aspects with some spots slightly reddened, a moderate tumefaction and readily bleeding gums. Caries is absent in most of the subjects with eight years of exposure, and extremely rare in others. The percentage of caries was substantially lower in children in the vicinity of the plant than those of the same age group outside the district. The properties of fluorine, its pharmacology, toxicology, water toxicity, therapy, and prophyaxlis are reviewed.

11467

Miessner, H.

DAMAGE TO ANIMALS CAUSED BY INDUSTRY AND TECHNOLOGY. ((Schadigung der Tierwelt durch Industrie und Technik.)) Translated from German. Deut. Tieraerztl. Wochschr., 39, p. 340-345, 1931. 26 refs.

Pollution of the air and damage to feed plants, and the resulting diseases of humans and animals, are extremely frequent in regions where ore-processing metallurgical plants are located. The fumes being produced during roasting and melting of the ore are usually bonded to sulfur and arsenic; consequently the smoke contains considerable quantities of SO2 and As2O3. This smoke most affects cattle. Acute arsenic intoxication becomes manifest in the form of vomiting and diarrhea, caustic injuries to the gastric mucosa, and fatty degeneration of the liver. In chronic cases, increasing cachexia, eczema and weakening resembling paralysis are observed. The metallic elements in the fly dust, moreover, can lead to harmful indigestion. During acute lead poisoning, stomach distress is observed, as well as spastic movements. Chronic lead intoxication leads to a general malaise combined with abortion, lead colic, muscular pair., epilepsy, and paralysis. The red blood corpuscles show a partial basophilic granulation. Hydrofluoric acid fumes from foundries and plants producing artificial fertilizers dissolve the calcium in the bones, and chronic calcium degradation and softening of the bones are the consequences. As a result of an air pollution episode in Luttich, damage by foundry smoke in fog caused hundreds of persons to fall ill and 63 to die, mostly within 1 to 2 days. Hardest hit were asthmatic and heart patients, and persons suffering from bronchitis. Copper intoxication was observed in sheep and cattle as a result of spraying orchards with lime and copper.

11942

Babayants, R. A.

INFLUENCE OF URBAN AIR POLLUTION ON THE HEALTH OF INHABITANTS. Vestn. Akad. Nauk SSSR, 14(12):3-12, 1959. 15 refs. Translated from Russian. 15p.

A survey of the influence of air pollution in general and of several air pollutants (carbon monoxide, sulfur dioxide, fluorides, aerosols) on the health of humans in the U.S.S.R., is given. The first study dates back to 1933 and has become important primarily for the method used. The first broad study was conducted in 1948- 1949 where relationship between the incidence of lung, throat and tonsil pathology and air pollution was established as 1.5 to 8.1 times higher in the polluted area than in the control area. Subsequently, a clear relationship

between eye disease and air pollution could be established. A study of school children in polluted and non-polluted areas revealed that changes of the lung image were five times as common among the children in the polluted area. In later studies, catarrhs, tonsilities, influenza and bronchitis were related to air pollution. A regional investigation conducted in Baku in 1955 revealed a correlation between bronchitis and laryngotracheitis and air pollution by aerosols. Similar results were obtained in a study in 1954-1955 in the Ukraine. A study of the influence of CO on traffic officers revealed that 68% of the officers exposed to concentrations of 25 mg CO/cu m had a carboxyhemoglobin of 11%. Tests in gas-heated apartments revealed a similar high incidence of CO intoxication. An investigation of the effects of SO2 on animals revealed that respiratory disturbances began to develop at 2 mg/cu m. The increase of lung cancer is attributed to carcinogenic pollutants such as 3,4-benzpyrene. A higher number of persons with mottled teeth from the effects of fluorine emissions were found close to the source than at more remote distances from the source.

11945

Demole, V., T. von Fellenberg, A. J. Held, and H. Schmid

FLUORINE, DENTAL CARIES, AND THE THYROID GLAND. Bull. Schweiz. Akad. Med. Wiss. vol. 7:440-462, 1951. 8 refs. Translated from French. 31p.

Analyses of the soil, water, and plants and examinations of several groups of children between the ages of 7 and 15 with the same ethnological background in different parts of Wallis (Switzerland) showed a relationship between the environmental fluorine content and the fluorization of the hard dental tissues and their resistance to caries. In the Sembrancher area, where the drinking water contains 1.4 mg of fluorine/l, the resistance to dental caries is much higher than in children living in the vicinity of Le Chable where the fluorine content of the water is only 0.05 mg/l. Some white stains on the enamel of the children's teeth were observed in Sembrancher, but no definite relationship could be established between the high fluorine content of the water in this village. The development of the thyroid gland in children was about the same, whether they came from areas with fluorine-rich or fluorine-poor water. In the area richest in fluorine (Sembrancher), no goiters were observed in 15-year-old boys and girls who were native to the area and had drunk the water since birth. These facts permit confirmation of the existence of a biological iodine-fluorine antagonism.

12282

Sadilova, M. S.

STUDIES IN THE STANDARDIZATION OF MAXIMUM ALLOWABLE HYDROGEN FLUORIDE CONCENTRATIONS IN THE AIR OF INHABITED AREAS. In: The Biological Effects and Hygienic Importance of Atmospheric Pollutants, Book 10. Translated from Russian by B. S. Levine, U.S.S.R. Literature on Air Pollution and Related Occupational Diseases, Vol. 17, pp. 118-128, 1968. CFSTI: PB 180522T

An investigation of the levels of atmospheric fluorine found near aluminum and cryolite plants, accompanied by a survey of the health of children who live in these areas has shown that the establishmen of the maximum allowable concentration of fluorine is imperative. series of tests made on human subjects and animals exposed to hydrogen fluoride yielded the following information: The odor perception threshold and the threshold of reflex action of HF in th human organism are both 0.03 mg/cu m. Five-month experimental inhalation of HF in concentrations of 0.10 and 0.03 mg/cu m produce many changes in warm-blooded animals: (a) inhibition in the centru nervous system, the higher concentration leading to irreversible destructive changes in the nerve cells; (b) a change in calcium phosphate metabolism; (c) F accumulation in the bones; and (d) histomorphological changes in teeth, bones, and internal organs. I was found that the extent of the changes varied with the HF concentration in the inhaled air. An HF concentration of 0.01 mg/cu m produced no changes in the experimental animals. Finally, the investigation showed that: (a) an HF concentration of 0.15 mg/cu m cannot be regarded as threshold of odor perceptive concentrations; (b) an HF concentration of 0.03 mg/cu m cannot be taken for the maximum allowable single-exposure concentration; (c) the maximum single-exposure concentration of HF must not exceed 0.02 mg/cu m.

12403

Dost, Frank N., Donald J. Reed, Arthur Finch, and Chih H. Wang

METABOLISM AND PHARMACOLOGY OF INORGANIC AND FLUORINE CONTAINING COMPOUNDS. Oregon State Univ., Corvallis, Radiation Center, Contract AF 33(615)-1799, Proj. 6302, Task 630202, AMRL-TR-67-224, 91p., Aug. 1968. 47 refs. CFSTI, DDC: AD 681161

Studies were made on rats of the toxicology and chemistry of several compounds considered for deployment as oxidizers in missile propulsion: nitrogen trifluoride, tetrafluorohydrazine, chlorine trifluoride, bromine pentafluoride, and oxygen difluoride. The lethality of each agent by inhalation was determined, using an exposure chamber, as well as estimates of lethality after intraperitoneal administration. Experimental evidence suggests that the lethal effect of interhalogens is by corrosive local destruction of pulmonary surfaces, resulting in failure of gas exchange. Oxygen difluoride is thought to pass intact into the pulmonary cells where it reacts with biochemical reducing systems to ultimately cause cell death and structural failure. This agent is considered one of the most lethal of all chemicals and the development of an antidote is considered of critical importance. The nitrogen fluorides both cause intrinsically lethal levels of methemoglobin formation, but other pharmacologic activity by these compounds or their derivatives may also contribute to their toxic activity. (Author abstract modified)

12532

Gudjonsson, S. V.

((CRYOLITE POISONING.)) Kryolitherkrankung. Text in German. Arztliche Sachverstandigen Zeitung, 41(12):155-157, Jun. 1935.

A new disease was discovered in Copenhagen, Denmark, through X-ray examinations of the workers in the cryolite plant. Cryolite is a fluorine containing mineral which is presently only mined in Greenland. Only two factories in the entire world (in Canada and Denmark) process this mineral. It is used in the production of enamel and opal glass. In aluminum fabrication it serves as catalytic agent. In an examination of 80 workers occupied with the grinding of the material it turned out that they all felt pains in their limbs and complained about lack of appetite, nausea and fatigue. They all walked with a stiff back. The X-rays showed serious deformations of the skelton. The lungs had the appearance of those of silicosis patients. But silicic acid, the cause for silicosis, is hardly a major component of cryolite. The cause for the disease was found in the fluorine contents of the cryolite. This assumption can be verified by laboratory experiments conducted with rats, dogs, calves, pigs, and sheep. Another in-

teresting observation has been made. During a volcanic erruption b about 150 years ago - numerous animals and humans died. Examinations of the bones of animals which died at that time showed that they suffered from serious fluorosis. Thus not only cryolite plants but also volcanic areas can be hazardous in this respect, not to speak of aluminum and other plants.

12547

Craste, C.

FLUORIC POISONING. (CONTINUED.) (L'intoxication fluoree.) Text in French. Rev Med Veterinaire, 103:214-221. 1952.

The toxicity of milk produced by animals struck with fluorosis or fluoridosis is difficult ot ascertain. This was shown in the experiments on rats by the Wisconsin (U.S.A.) Agricultural Station (1934). Work by Thieberox on young French children in the vicinity of aluminum factories fails to determine whether their absorption of fluorine is due to their drinking of milk from affected cows or their inhalation of polluted air. Radical prophylaxy of fluorisis and fluoridosis could be achieved by suppressing the toxic emanations from the aluminum factories. These emanations pollute the neighboring agricultural establishments. Cattle struck by 'factory disease' were found as far as 25 km from five factories in the Maurienne and Gard areas. Public authorities and electrometallurgical companies are involved in the solution of the problem. Their reluctance to act may lead the public to resignation, were it not for the fact that one factory in the Alps has successfully prevented the disease in its area. But it keeps its method secret, and only the public authorities may, some day, force its disclosure. Fluoric poisoning can be cured only when caught early. The best treatment is to eliminate all toxic fodder from the animals' diet, since the origin of the 'factory disease' is exclusively of a digestive nature. To do this, the flock is moved to some unpolluted area. This treatment will result in permanent cure. Medical treatment can be considered only as complementary.

12549

Craste, C.

FLUORIDE POISONING. ((L'intoxication fluoree.)) Text in French. Rev Med Veterinaire, 103:142-148, 1952. 9 refs.

Subacute and chronic forms of poisoning are, clinically and anatomopathologically, closer to each other than has been claimed. Bone lesions (marmoration, narrowing of marrow channels) cause brittleness and fractures. Dental lesions (mottled enamel of permanent teeth) are found in North America, Brazil, Argentina, North Africa. Tooth decay and g..agivitis made chewing difficult, the animal wastes away and loses its value in the rural economy. Fluoridosis (sodium fluoride poisoning through water intake and calcium fluoride poisoning through vegetable intake) appears slowly in factory workers handling natural phosphates. Fluorosis, caused by hydrofluoric acid, appears suddenly in plants and animals downwind from the factory. In cryolite factories, lombar ankylosis and muscular calcification may appear, and even kidney and liver lesions, emaciation, and cachexy. All farm animals may be subject to fluorosis. Goats and cattle are highly sensitive, horses quite resistant; poultry may also be affected. Speed of evolution depends on food toxicity, the richness and variety of the diet, and on the activity of the infection generating centers and factories. Pathology: Fluorine acts on the parenchyma, the general metabolism, and calcium metabolism. Depending on the dose of the compound, the action may be acute (toxic action with sudden decalcificatio() or subacute (on the parenchyma and general metabolism) or chronic (on phosphocalcium metabolism). Fluorosilicates are highly toxic. Sodium fluoride decalcifies and marmorizes the bones.

12550

Cristiani, H. and R. Gautier

FLUORINE FROM THE VIEWPOINT OF INDUSTRIAL HYGIENE: ACTION OF FLUORINE ON ANIMALS. ((Le fluor au point de vue de l'hygiene industrielle: action du fluor sur les animaux.)) Text in French. Ann. Hygiene Publ. (n.s.), 3:210-233, 1925. 50 ref

Acute poisoning by sodium fluoride may be produced by intestinal absorption of 0.5 gr per kg of animal or by veinous absorption of 0.1 to 0.15 gr per kg of animal. Chronic cases by absorption of smaller doses also set forth. The toxicity of fluorsilicic acid seems due to its low dissociation power and high content of HF molecules. The relation between emanations from aluminum factories and the endemic sickness prevailing in the surrounding area, as described in the literature, is confirmed by the authors' experiments on a particular installation: (1) plants were damaged soon after the factory began operating; characteristic foliage lesions appeared on vine and fruit trees, and reduction of the crops coincided with the factory activity. (2) Cattle showed stiffening of the legs, loss of weight, bone fracture, cachexy, and death. Tabulated data and maps support these observations. (3) On humans, no positive conclusions are yet available. They are less affected than animals, since the latter are poisoned by feeding on damaged plants, whereas the former clean and prepare these plants before consuming them; and poisoning of humans through toxic gases is minimized by the conditions (temperature, distributio() existing within the factory.

12555

Firket, J.

COMPARATIVE PATHOLOGY AND AIR POLLUTION. ((Pathologie comparee et pollutions atmospheriques.)) Text in French. Congr. Intern Pathol. Com., 7th Lausanne, 26-31st May 1955. 7(2):57-80.

Air pollution factors include the chemical action of gases and vapors, the physical action of particle suspensions (aerosols), and the reaction of certain pollutants turning harmless gases into toxic ones. This report stresses the pathological aspects of air-pollution poisoning as evidenced by the fatal accidents in Belgium (1932), Donora, Pa. (1948), and London (1952), where geographical and meteorological factors helped in the formation of a fog umbrella and critical pollutant concentrations over the area. Physiological effects of certain gases and vapors in industrial atmospheres are shown in Table I. The penetration of dusts into the lungs depends upon their sizes (micronic, submicronic, submicroscopic) and on the presence of fog. The pathogenic action begins with an irritation of the respiratory mucous membranes, slow paroxystic expiration, followed by vascular collapsus, low blood pressure. Postmortem toxicological tests were negative. Fog induced asthma and emphysema have affected Belgian cattle since 1911. Goats, sheep and cattle have contracted fluorosis from fluorine and fluorine dusts discharged into the air by industry. Sheep in the vicinity of a fluorine processing plant developed dental and osseous lesions. Other aspects of 'civilization sicknesses' arise from our changing environment, the use of insecticides on vegetation, the presence of smokes, gases, fluorine in the air. The relation of air pollution to primary lung cancers is considered for certain trades and professions. Statistics seem to indicate tobacco smoke (in cigarettes) to predispose to lung cancer, without, however, determining it.

12987

Moese, J. R., H. Brantner, and G. Fischer

AIR POLLUTION STUDIES IN THE GRAZ AREA. 3. INVESTIGATIONS OF THE CORRELATION AND MEANING OF FLUORIDE EMISSION AND FLUORIDE EXCRETION IN THE KIDNEY. (Studien uber die Luftverunreinigung im Raum Graz. 3. Mitt.: Untersuchungen uber Zusammenhang und Bedeutung von Fluorimmissionen und Fluorausscheidung in Harn). Text in German. Arch. Hyg., 153(2):114-118, April 1969. 7 refs.

Fluoride excretion in the urine was determined in population groups living in various industrial areas of the city of Graz, Austria. A total of five groups was selected. The first group consisted of workers in a brickyard outside the residential area of Graz. The workers resided in the immediate vicinity of the brickyard. The second group included workers in this brickyard who lived in the country. The third group (control group) lived and worked outside the region of the brickyard. The fourth group included members of a shoe factory in the industrial center of Graz. The last group consisted of persons living in a nearby resort remote from any industries. The highest amount of fluoride was found in the first group, the lowest in the group from the resort town of St. Radegund. Thus, a marked correlation between fluoride excretion and the degree of air pollution could be found. The concentrations found in the fourth group were markedly higher than those in the third group, due to industrial emissions and domestic heating. In none of the groups did the concentration reach the level of acute intoxication. Nevertheless, such groups should receive special attention in such programs as caries prevention by distribution of fluorine-containing tablets.

13215

Colombini, M., C. Mauri, R. Olivo, and G. Vivoli

EXPERIMENTS ON RABBITS FED FORAGE GROWN NEAR AN ALUMINUM FACTORY. Fluoride Quarterly, J. Intern. Soc. Fluoride Res., 2(1):49-54, Jan. 1969. 2 refs.

Skin lesions resembling bruises were exhibited by individuals living near an aluminum factory in Chizzola, Italy. To study the etiology and pathogenesis of this phenomenon, male albino rabbits were fed forage grown near the factory and forage artificially contaminated by substances collected from the factory's purification system. At regular intervals, serum alkaline phosphatase, serum calcium, serum phosphate, leucocyte alkaline phosphatase, and nonspecific esterases were determined. After about five months, the animals were killed and fragments of their tibia were analyzed for fluoride. The serum alkaline phosphatase, calcium, and phosphorous levels did not show any significant changes in the treated animals. A decrease in the leucocyte alkaline phosphatase activity of positive cells was observed. Nonspecific esterases were present in very small quantities in pseudo-eosinophils, in traces in lymphocytes, and in slightly greater amounts in monocytes. The fluoride content of the bones of treated rabbits was almost twice as high as that of control rabbits, who received forage from uncontaminated areas. (Author summary modified)

13700

Balazova, G., P. Macuch, and A. Rippel

EFFECTS OF FLUORINE EMISSIONS ON THE LIVING ORGANISM. Fluoride Quarterly, J. Intern. Soc. Fluoride Res., 2(1):33-36, Jan. 1969.

Health parameters were measured in children living in an area near an aluminum factory. In the area near the factory, excessively high F levels were found in the air and in dust. This fact was reflected in high F levels of agricultural products. High F levels were noted in urine, hair, nails, and teeth in the child population residing in the immediate vicinity of the factory. In children living in the exposed area since birth, hemoglobin values were lower and erythrocyte values were higher than in a control area. The average daily total F intake was calculated at 2.15 mg for the exposed children as compared with about 1 mg in the controls. (Author summary modified)

14112

Balazova, G. and A. Rippel

A STUDY OF THE HEALTH CONDITIONS OF THE PEOPLE LIVING AROUND AN ALUMINUM FACTORY. (Studio sulle condizioni di salute della popolazione abitante nelle vicinanse di una fabrica di alluminio). Text in Italian. Med. Lavoro (Milan), 59(5):376-380, 1968. 4 refs.

The physical condition of children living in the area of an aluminum factory was studied. Ambient air around the factory was heavily polluted by fluorine and high concentrations of fluorine were present in the agricultural products of the region. In the children examined, absorption of fluorine by digestive and respiratory systems was approximately 2.15 mg/day. In contrast to children living considerable distances from the factory, these children showed marked increases in the fluorine content of their teeth, nails, hair, and urine. Clinical and laboratory studies indicated a moderate decrease of hemoglobin values and a slight increase of red blood cells among the affected children.

14126

Macuch, P., J. Kortus, G. Balazova, and J. Mayer

EFFECTS OF SODIUM AND HYDROGEN FLUORIDES ON THE METABOLISM OF FLUORINE, CALCIUM, AND PHOSPHORUS IN RATS. Brit. J. Ind. Med. (London), 25(2):131-135, April 1968. 23 refs.

The effects of oral sodium fluoride and inhaled hydrogen fluoride on calcium and phosphorus retention are presented. Rats given 4 mg fluoride/kg/day for eight days excreted more calcium and phosphorus and retained less than the control group. In bone ash from rats given different fluoride doses for 40 days, the calcium and phosphorus were maximal after a total dose of about 250 micrograms of fluoride/rat but fell to subnormal levels after higher doses. The calcium and phosphorus levels in bone ash from rats given 750 micrograms of fluoride/day fell with the duration of treatment. Rats exposed to 9.4 to 11.7 micrograms of hydrogen fluoride/liter air absorbed fluoride rapidly, as shown by increased urinary excretion, by changes in the tooth enamel, and by rising fluoride levels in the teeth and bones. Radiological examination, however, showed no gross changes. It was evident that fluoride under different conditions affected the metabolism of calcium and phosphorus differently and also that some calcium compounds reduce the toxicity of a high fluoride intake. Fluoride caused the same changes whether given by inhalation or in the diet. The analyses for fluorides in the first samples of urine after an exposure of only three days showed raised levels. Although in the experiment, the concentration of fluoride in the urine in different specimens were variable, the mean concentrations from the series of tests showed as increased excretion with the increased duration of exposure.

14319

Cavagna, G., G. Locati, and L. Ambrosi

EXPERIMENTAL STUDIES IN NEWBORN RATS AND MICE ON THE SUPPOSED CAPILLARY-DAMAGING EFFECTS OF FLUORINE AND FLUORINE-CONTAINING INDUSTRIAL

POLLUTANTS. Med. Lavoro (Milan), 60(4):267-273, 1969. 12 refs.

Bluish skin-spots occurring in women and children living in the vicinity of a fluorine-emitting aluminum factory have been attributed to a poorly understood capillary-damaging effect of fluorine. To clarify this phenomenon, a study was carried out on rats born of mothers which were injected subcutaneously for the whole pregnancy period with NaF and an extract of dust emitted from the aluminum factory at a dose of 2 mg fluorine per day. The total dose of fluorine given was 40-52 mg. No cutaneous lesions, or even an increased capillary fragility of the skin, as proved with the suction cup test were observed. In a second experiment, newborn rats were injected subcutaneously with NaF and the dust extract at a dose of 0.2 mg fluorine per day in the first 10 days of life. Again no cutaneous lesions or increased capillary fragility of the skin were observed. Studies on subacute toxicity were carried out in female mice injected subcutaneously with NaF and with the dust extract in a dose of 0.2 mg fluorine per day for 24 days. No cutaneous lesions or capillary alterations as studied in histologic preparations of the mesentery were observed. (Author summary modified)

14477

Moese, J. R., G. Fischer, and H. Brantner

STUDIES ON AIR POLLUTION IN THE GRAZ AREA. IV. ON THE MEANING OF INCREASED FLUORINE EXCRETION IN THE KIDNEY AS A MEASURE OF THE FLUORINE BURDEN OF A LARGE CITY POPULATION. (Studien ueber die Luftverunreinigung im Raume Graz. IV. Mitt.: Ueber die Bedeutung der erhoehten Fluorausscheidung im Harn als Massstab fuer die Belastung der Grosstadtbevoelkerung durch Fluorimmissionen). Text in German. Arch. Hyg. Bakteriol. (Munich), 153(3):234-238, 1969. 4 refs.

Since fluorine discharge in the urine has been found to be a good relative measure of the fluorine concentration in the atmosphere, various selected groups of the population in and around Graz were used for continuation of earlier studies. Of the four groups, one was made up of residents of the moderately populated suburbs, one of residents of an industrial section of the city, and one of residents of a densely populated residential area. The fourth group was used as control group with its members coming from a resort town located 400 to 500 m above sea level in a forested area. The highest fluorine concentrations in the urine were found in the groups from the industrial and densely populated residential areas. Average concentrations of 0.85 plus or minus 0.015, 0.91 plus or minus 0.007 and 0.63 plus or minus 0.014 mg F ions per 1000 ml urine were found in the former group and 0.85, 0.86 and 0.81 mg F ions per 1000 ml urine in the latter group. It is striking that the values of the two groups are almost the same. This can be explained by the fact that mostly coal-fired domestic heaters were used in the residential area under study. The normal value for fluorine discharge in the urine of 1 mg per 1500 ml urine per day was exceeded slightly by the majority of persons in these two groups. Although there is no danger of acute or chronic fluorine intoxication among the population in these two areas, there is clearly a higher fluorine intake from the air. This fact should be considered in the distribution of fluorine tablets or fluorine-containing toothpaste.

15040

Agate, John N., G. H. Bell, G. F. Boddie, R. G. Bowler, Monamy Buckell, E. A. Cheeseman, T. H. J. Douglas, H. A. Druett, Jessie Garrad, Donald Hunter, K. M. A. Perry, J. D. Richardson, and J. B. de V. Weir

INDUSTRIAL FLUOROSIS: A STUDY OF THE HAZARD TO MAN AND ANIMALS NEAR FORT WILLIAM, SCOTLAND. Med. Res. Council Memo. 22(1949), 131p. 192 refs.

The effects on health of fluorine escaping from an aluminum factory were studied. Fluorine concentrations in the factory room were as high as 3.60 mg/cu m and outside the factory varied from 3-15% of the average factory room concentration, depending on the distance from the factory. It was established that chronic endemic dental fluorosis affecting both cattle and sheep occurs in the area near the aluminum factory. A substantial measure of osteodystrophia occurs in cattle grazing in this vicinity, and dental lesions are confined to animals reared on contaminated pastures. Cases of osteomalacia due to chronic fluorine intoxication was also found. Loss of milk in affected animals was severe. Volunteers from factory workers and from adults and schoolchildren living in the neighborhood were examined. The factory workers were divided into two groups; those working in the furnace room and those from other departments. The examinations covered full occupational and medical histories, complete physical examination, X-rays, and for selected individuals, a full blood count and an estimation of blood fluorine and urinary fluorine concentrations. The excretion of fluorine in the furnace-room workers ran parallel to the intensity of exposure. Some of the older workers, exposed for a number of years, showed bone changes recognized as fluorosis. Despite the bone changes, none of the workers were found to suffer clinical disability. Some degree of mottling was found in the teeth of schoolchildren, but mottling was also found in schoolchildren in an area which was far removed from the aluminum factory. Clinical examination of a number of resident in the neighborhood of the factory showed no injury to health. It was concluded that while direct exposure to fluorine does not impair the health of man and animals, fluorine emissions from the factory should be reduced. (Author summary modified)

15555

Waldbott, G. L. and V. A. Cecilioni

'NEIGHBORHOOD' FLUOROSIS. Fluoride Quarterly, J. Intern. Soc. Fluoride Res., 2(4):206-213, Oct. 1969. 9 refs.

Data obtained from medical examinations or medical histories established the presence of the nonskeletal phase of fluorosis 32 individuals living in areas near fertilizer factories and an iron foundry and where fluoride damage to vegetation, livestock, and to materials had been determined. The symptomology of the disease is identical with that of the nonskeletal phase of fluorosis recorded by others in industrial fluorosis, neighborhood fluorosis, hydrofluorosis, and fluoride intoxication from long-term administration of fluoride tablets. The musculoskeletal, gastrointestinal, and respiratory systems were principally involved. Fluoride assays of hay, flydust, human tissue, and urine are presented. Ten individuals exhibited the skin lesions designated as Chozzola Maculae which were recently described in population exposed to fluoride emanations near aluminum factories in Italy. It was concluded that fluoride emissions from the factories were the source of the illness. (Author summary modified)

16047

Chaneles, J.

ACTION OF IODINE ON CHRONIC FLUOROSIS. (Action de l'Iode sur la fluorose chronique). Compt. Rend., vol. 102:863, 1929. Translated from French. Public Health Service, Air Pollution Technical Information Center, 2p., Sept. 15, 1969.

Four groups of five rats each were subjected to a diet of bread and milk for 6 months. The rats in the first group were fed 50 mg/kg sodium fluoride per day; the second group, 2 mg sodium iodide per animal; the third group, fluoride and iodide at the same time; and the fourth group received neither of these substances. The growth of rats receiving fluorine was better than that of the control group for 3 months, then slackened, and on the sixth month was less. The hair was less silky and blood marks appeared at the nostrils and on the vagina. The rats that were iodized and fluoridized had the same symptoms, but more accentuated. Iodide given alone favored growth. The teeth of fluoridized rats had uniform whiteness and marked elongation of superior incisors. The enamel presented undulated prisms and numerous Retzius brown streaks; superficial pigmentation was completely lacking. In the group receiving fluoride and iodide, the alterations were less marked; the teeth were more compact. Bones and organs were also studied, but noted modifications were not substantial.

16345

Biersteker, K.

POLLUTED AIR. ORIGIN, MEDICAL SIGNIFICANCE AND COMBATING OF POLLUTED OUTSIDE AIR. (Verontreinigde Lucht. Ontstaan, medische betekenis en bestrijding van verontreinigde buitenlucht). Assen, Van Gorcum, 1966, 214p., 339 refs. Translated from Dutch. Franklin Inst. Research Labs., Philadelphia, Pa., Science Info. Services, 275p., July 29, 1969.

Factors affecting emissions are considered, together with trends in emissions in the Netherlands and Rotterdam. The qualitative and quantitative significance of air pollutants as potential disease agents in Rotterdam is evaluated. The maximum sulfur dioxide concentration so far recorded in Rotterdam is 1600 micron cu m; the maximum smoke concentration, 500 micron/cu m. No epidemiological significance is attributed to measured concentrations of fluorides, nitrogen dioxide, carbon monoxide, or lead. Concern is shown for the role of benzpyrene and other carcinogens in the etiology of lung cancer. Distinctions are made between acute, sub-acute, and chronic air pollution. During acute air pollution, SO2 and smoke concentrations in Rotterdam show five- fold increases. Sub-acute pollution occurs when wind speeds drop below 2 m/sec. Chronic air pollution is present on all other days, especially in winter. Though the effects of pollution can also be categorized as chronic, acute, and sub-acute, the level of air pollution is still too weak to cause illness. Methodologies employed in determining the relationship between air pollution and human mortality and morbidity are reviewed, and hypotheses developed to describe the effects of pollution on illness and death in Rotterdam. Refinements in analytical methods are urged so that the factors influencing increased chronic nonspecific lung disease mortality and lung cancer mortality can be identified. It is also suggested that emission standards be supplemented by regulations making it possible to restrict emissions when meteorological data and monitoring station readings point to certain dangers.

16874

Waldbott, G. L. and V. A. Cecilioni

'NEIGHBORHOOD' FLUOROSIS. Fluoride Quart. Repts., 2(4):206-213, Oct. 1969. 9 refs.

In 32 individuals residing near fluoride-emitting fertilizer factories and an iron foundry where fluoride damage to vegetation, livestock and to materials was established, evidence of the non-skeletal phase of fluorosis is presented. The symptomatology is identical with that of the non-skeletal phase of fluorosis recorded by others in industrial fluorosis, in 'neighborhood' fluorosis, in hydrofluorosis and in fluoride intoxication from long-term administration of fluoride tablets. Principally involved are musculoskeletal, gastro-intestinal and respiratory systems. Fluoride assays of hay, flydust, food, human tissue and urine are presented. Ten individuals exhibited the skin lesions designated as 'Chizzola Maculae' which have been described recently in populations exposed to fluoride emanations near aluminum factories in Italy. (Author's Summary)

16916

Alpaugh, E. L., K. A. Phillippo, and H. C. Pulsifer

VENTILATION REQUIREMENTS FOR GAS-METAL-ARC WELDING VERSUS COVERED-ELECTRODE WELDING. Am. Ind. Hyg. Assoc. J., 29(6):551-557, Nov.-Dec. 1968. 6 refs.

Comparative tests were undertaken of the amounts of particulate and gaseous byproducts generated by gas-metal-arc welding and covered-electrode welding processes to determine if the same ventilation requirements apply to both processes. Solenoid values set for inhalation and exhalation times observed in the normal adult male were used to stimulate breathing by a plaster dummy head mounted on a movable welding head carriage. Air samples were taken concurrently inside and outside the welding helmet worn by the dummy. Samples were analyzed for iron oxide, nitrogen dioxide, ozone, fluorides, and carbon monoxide. The gas-metal-arc welding process was represented by five wire electrodes, three of which were flux-cored, and five shielding gases. A standard covered electrode was used for comparison purposes. Contaminant levels generated by the two processes were comparable, and it is concluded that more stringent regulations for either process would be unreasonable. In addition, the study offers evidence that the welding helmet is an effective barrier against the particulate and gaseous byproducts. Consequently, air samples taken adjacent to the helmet yield exaggerated exposure results in welding surveys. Contaminant concentrations are tabulated.

18785

Schrenk, H. H.

CAUSES, CONSTITUENTS AND PHYSICAL EFFECTS OF SMOG INVOLVED IN SPECIFIC DRAMATIC EPISODES. Arch. Ind. Hyg. Occupational Med., 1950:189-194, 1950. (Presented at the American Medical Association, Annual Meeting, 98th, Atlantic City, N. J., June 8, 1949.)

The Meuse Valley and Donora, Pa. air pollution episodes are discussed. A primary factor in both incidents was the unique weather conditions. In the Meuse Valley a temperature inversion and anticyclonic conditions lasted from Dec. 1 to 5, 1930, and in Donora, from Oct. 27 to 31, 1948. These prolonged periods of static air conditions allowed the accumulation of atmospheric pollutants. About 30 atmospheric constituents in the Meuse Valley were identified indirectly by visiting the plants in the area and obtaining information concerning raw materials, intermediates, gases, and fumes. The investigations showed that those particularly affected by the fog were elderly persons and asthmatic or cardiac patients. Sulfur dioxide and its oxidation products produced the injurious effects. In Donora, physicians, nurses, dentists, veterinarians, statisticians, engineers, chemists, sanitary engineers, housing experts, and meteorologists collected data pertaining to the incident. Stack gases and the general atmosphere were sampled for sulfur dioxide, chlorides, fluorides, nitrogen oxides, arsine, stibine, carbon monoxide, carbon dioxide, and oxygen. Particulate matter and soot-fall were also collected. The analysis of the information and data obtained and the correlation of clinical, environmental, and meteorologic findings are in progress.

18809

Hoschek, R.

THE BIOLOGICAL EFFECT OF RARE EARTHS. (Die biologische Wirkung von Seltenen Erden). Text in German. Zentr. Arbeitsmed. Arbeitsschutz, 16(6):168-172, 1966. 11 refs.

Photo-reproduction workers were tested with x-rays. They had been exposed to the fumes of electric arc light carbons in their jobs. Changes were found on their lungs resembling the silicosis pattern, but mostly without any clinical symptoms. Since the deposits on the lungs were essentially cerite fluorides, experiments were made with guinea pigs, who were given intratracheal injections of rare earth preparations containing cerite fluorides and alternatively cerite oxides. The animals lungs showed either nests of dust accumulation, or more diffused dust deposits, causing structural changes in the fibers locally surrounding the dust material. The type of change also depended on the duration of the experiments, some of which extended over nine months or longer. The overall conclusion was that, compared with the effects of silica dust, this rare earth dust is practically inert.

18987

Laidlaw, S. I. A.

THE EFFECTS OF SMOKE POLLUTION ON HEALTH. J. Inst. Fuel, vol. 36:96-99, Feb. 1954. (Presented at the Institute of Fuel, Scottish Section, Glasgow, Scotland, Oct. 15, 1953.)

The health effects of several air pollutants are discussed. One effect of a polluted atmosphere is a dimunition of sunlight. This may lead to lowered vitality and lowered resistance to infection. A lack of sunlight can also cause a reduction in vitamin D production, and thus lead to rickets and carious teeth. The particulate pollutants discussed include dust, soot, and fog. Dust has an aggravating effect on respiratory tract infections and causes certain forms of dermatitis and inflammatory conditions of the eyes and ears. It can also cause fibrosis, silicosis, and anthracosis. The long-term accumulation of soot deposit in the respiratory tract is a contributory factor to certain diseases, such as catarrh, sinusitis, and bronchitis. It may also contain traces of carcinogens such as arsenic and benzpyrene. Dust and soot are more harmful when they form nuclei for droplets of moisture and form fog. In the London fog of 1952, the death rates from bronchitis, pulmonary tuberculosis, and heart and circulatory disorders rose markedly. Several gaseous pollutants are discussed, including sulfur dioxide, fluorine, carbon monoxide, and beryllium compounds. Sulfur dioxide affects humans, animals, vegetation, and materials. Fluorine causes changes in bone structure, known as fluorosis. The effect of CO on the body is to cause anoxia. Acute and chronic lung disease and skin lesions have resulted from exposure to beryllium compounds. The possibility that air pollution may be one cause of bronchial carcinomas is also discussed.

18988

Wallace, A. S.

MORTALITY FROM ASTHMA AND BRONCHITIS IN THE AUCKLAND FUMES AREA. New Zealand Med. J., 56(313):242-249, June 1957. 1 ref.

Onehunga and Otahuhu lie in a part of Auckland, New Zealand, where there is heavy industry, adjacent to the heavily polluted Mangere Inlet. Residents have complained of choking or malodorous fumes. In late summer and autumn paint-staining episodes have occurred during temperature inversions, suggestive of hydrogen sulfide concentrations of about 1 ppm. The atmosphere may also contain detectable concentrations of sulfur dioxide, nitrogen dioxide, sulfuric acid mists, fluorine-containing acid mists, lead fume, and various organic compounds at any season of the year. The death rates from asthma and bronchitis for the years 1951-1955 inclusive in Onehunga and Otahuhu are compared with those from Mt. Albert, a predominantly residential area. There were more deaths from asthma and bronchitis per 100,000 population in Onehunga and Otahuhu than in Mt. Albert. The actural deaths in the fumes area exceeded those of the control area in each year separately except 1953. However, the actual numbers involved are too small for the application of tests of significance or to warrant drawing any firm conclusions. The acute paint-staining fume attacks were not associated with any apparent immediate increase in mortality from asthma or bronchitis. (Author summary modified)

19055

Marier, J. R.

FLUORIDE RESEARCH. Science, vol. 159:1494-1495, March 29, 1968.

At the first meeting of the International Society for Fluoride Research, 32 papers dealing with dental, skeletal, cytological, diagnostic, analytical, and related factors in fluoride research were presented. Various mechanisms that may explain the anticarcinogenic effect of fluoride were discussed. It was concluded that this is due to a fluoride-induced reduction in the solubility of surface enamel apatite. Fluoride can inhibit streptococcus-induced osteolysis of alveolar bone in dental infections of pulpal origin. Chronic ingestion of alcohol may aggravate skeletal fluorosis. Crippling fluorosis has been related to the fluoride content of drinking water. The effects of aluminum lactate and aluminum sulfate in alleviating symptoms of fluorosis were studied. A daily dose of 24 mg/kg aluminum lactate reduced skeletal fluoride storage by 50%. Fluoride also caused skin lesions in the extremities and lumbosacral region. These lesions may serve as diagnostic criteria in subjects exposed to industrial fluoride emissions. Discoloration and disfiguring of vegetables were also caused by fluoride. Children in an industrial area where fluoride is emitted had decreased hemoglobin and increased erythrocyte level, with two to three times more fluoride in their teeth, fingernails, hair, and urine than children in a control area. It is recommended that research in this area continue.

19148

Feldstein, Milton

TOXICITY OF AIR POLLUTANTS. Bay Area Air Pollution Control District, San Francisco, Calif., 20p., 1963. 70 refs.

'Oxidizing' air pollution, resulting from photochemical processes which occur in the atmosphere, is distinguished from 'classical' air pollution, the predominating features of which are the presence of sulfur dioxide, industrial dusts, and soot. The processes leading to the formation of photochemical smog are summarized, as are the meteorological, topographic, and solar energy factors influencing the intensity of photochemical smog episodes. Classical and photochemical air pollution may coexist. The principle effects of photochemical air pollution are eye irritation, vegetation damage, and visibility reduction. Other possible effects are also pointed out on health of acute or chronic exposure to photochemical smog and one or more of its specific components. The components include carbon monoxide, ozone, nitrogen oxides, lead, sulfur oxides, fluoride, beryllium, hydrogen sulfide, polynuclear hydrocarbons, and particulates.

19215

Tsunoda, Humio

THE INFLUENCE OF AIR POLLUTION BY FLUORIDE ON THE HUMAN HEALTH. (PART 1). (Fukkabutsu niyoru taikiosen to ningen no kenko (sono 1)). Text in Japanese. Kogai To Taisaku (J. Pollution Control), 6(7):504-508, July 15, 1970.

Air pollution by fluorides has two main aspects: the fluorides are extremely toxic for plants, parts per billion being critical for most plants, and the fluorides are accumulated in plants. Livestock feeding on them develop chronic fluorosis. To survey the air and environmental pollution caused by fluorides around the large aluminum plant in Fukushima Prefecture, a high volume air sampler was used. Within 1 km from the factory, 5.2-14.0 mg of fluorine per 1 cu m air was observed. Secondly, a relative measurement by lime treated filter paper technique was employed. The fluorine concentration in the factory was 100 times that of the adjacent villages. A method of airborne particulates was used to monitor the fluorine concentration. In the factory premises, the particulate concentration was 20 times as dense as that in villages. The fluoride pollution of the soil and subterranean water was also monitored. Among vegetables and cereals cropped in the area, some of the green vegetables showed 10 times more fluoride content than in plants from other areas. The inhabitants of the area take in 4.2 mg fluorine daily, which is above the daily limit of 3.5 mg of an average Japanese. After the physical check-up of the inhabitants, dental fluorosis, skeletal fluorosis, and crippling fluorosis were found.

19880

Balazova, G. and A. Rippel

A STUDY OF HEALTH CONDITIONS OF THE POPULATION LIVING IN THE VICINITY OF AN ALUMINUM FACTORY. (Studio sulle condizioni di salute della popolazione abitante nelle vicinanze di una fabbrica di alluminio). Med. Lavoro (Milan), 59(5):376-380, 1968. 4 refs. Translated from Italian. Belov and Associates, Denver, Colo., 6p., Jan. 27, 1970.

The health conditions of children living near an aluminum factory were studied. The ambient pollution from fluorine emitted by the factory was very high. High fluorine values were found in the agricultural products of the areas near the factory. In the children examined, the absorption of fluorine by the digestive and respiratory systems was approximately 2.15 mg/day. The children showed a marked increase in the fluorine content in their teeth, hair, nails, and urine when compared with children living in a non-polluted area. Clinical and laboratory studies revealed a moderate decrease in hemoglobin values and an increase in the red blood cell count in children exposed to a high absorption of fluorine. When some of the children were transferred to a non-polluted zone, the urinary excretion of fluorine decreased by 40% after one month. It may, therefore, be assumed that the accumulation of fluorine is reversible. (Author summary modified)

21455

Keplinger, M. L.

EFFECTS FROM REPEATED SHORT-TERM INHALATION OF FLUORINE. Toxicol. Appl. Pharmacol., vol. 14:192-200, 1969. 10 refs. (Presented at the Soc. of Toxicology, 7th Annu. Meet., Washington, D. C., 1968.)

Mice, rats, and rabbits were exposed to fluorine for 5, 15, 30, or 60 minutes at intervals ranging from 24 hours to one week; animals were sacrified immediately after the last exposure, or at 7, 14, 21, or 45 days after the last exposure. A single exposure caused marked changes in the lungs and some changes in the liver and kidneys. After four exposures to the same concentration, the lungs had slight changes; livers were normal. Kidneys showed sligh changes at 7 and 14 days, but were normal at 21 and 45 days. Therefore, four exposures to fluorine caused no more damage than a single exposure to the same concentration. Repeated exposures were made with different concentrations during each exposure. A low, apparently harmless level was used first; then 4, 24, and 96 hours later, the LC50 of fluorine was determined. The LC50's of pre-exposed animals were higher and there was less lung damage than in control animals. Exposures to a low concentration were also repeated every third day. At 1, 3, and 7 days after the last exposure the LC50's were determined. Even at 7 days the pre-exposed animals had higher LC50's and showed less lung edema than animals that were not pretreated by previous fluorine exposure. There may be some type of tolerance or protection developed by exposures to low fluorine concentrations. (Author abstract modified)

22551

Hodge, Harold C.

EFFECT OF FLUORIDES ON MAN. J. Air Pollution Control Assoc., 20(9):615-616, Sept. 1970. 3 refs.

The transcript of a court case involving ingestion and inhalation of fluorine compounds from an aluminum factory is quoted to illustrate symptoms of subacute fluorosis. The symptoms reported include dyspepsia and thyroid enlargement. Subacute fluorisis, as described in the transcript, has recently been equated with the nonskeletal phase of fluorisis, which is characterized by symptoms relating to muskuloskeletal, respiratory, and gastrointestinal symptoms. Typical of the disease is increasing general malaise and exhaustion leading to complete disability. As determined by other investigators, a relation appears to exist between the disease and fluoride exposure in patients living near a fertilizer factory and an iron foundry.

22628

Cecilioni, Victor A.

EFFECTS OF FLUORIDES ON MAN. J. Air Pollution Control Assoc., 20(9):614-615, Sept. 1970.

Issue is taken with a recent report indicating the relative immunit of man to even high levels of fluoride air pollution. Among the misleading conclusions of the articles are the contention that, wit few exceptions, the health of persons living near installations emitting fluoride dusts and fumes is not adversely affected and that 10 ppm of airborne fluorides will not damage vegetation. The fact is that some persons, like some species of vegetation, are more susceptible than others to elevate atmospheric fluoride levels Considering that many species of plants are even more susceptible than man to the effects of fluorides, other countries have suggested that the maximum allowable fluoride air level be 1 ppb or less. There can be no doubt about the cumulative nature of fluoride effects in man or animals. While true osteosclerotic changes and even crippling fluorosis require many years exposure, 'neighborhood' fluorosis is known to produce early symptoms of fluorosis involving the musculoskeletal, gastrointestinal, and respiratory systems. The hazards of occupational exposure to fluoride are well documented, as evinced by a study of a fluorspar mine, where the average dust and fluorine concentrations were about 1 ppb. Among 53 deaths over a 10-yr period, 23 were due to pulmonary cancer, 29 times the average rate.

22629

Waldbott, George L.

EFFECTS OF FLUORIDES ON MAN. J. Air Pollution Control Assoc., 20(9):614, Sept. 1970. 12 refs.

The validity of recent air quality criteria for fluorides is questioned because the criteria were derived from standard epidemiological procedures rather than a careful evaluation of clinical data available on individual cases. It is emphasized that the adverse effects of air pollutants on man cannot be determined by epidemiological surveys. Disputed conclusions of the fluoride survey are that fluoride can be stored in soft tissue in high magnitudes and that urinary fluoride excretion is a reliable index of fluoride intake. With respect to the former, information is not yet available on the extent of functional damage to organs that have stored high values. With respect to the latter, urinary fluoride excretion varies widely from patient to patient. Other shortcomings of the survey were its failure to consider total fluoride intake and its exclusion of patients with chronic diseases and diseases known to affect the bone structure. Lastly, the authors ignored the evidence that the Meuse Valley incident was due in large part to airborne fluoride.

23003

Tsunoda, Fumio

THE INFLUENCE OF AIR POLLUTION BY FLUORIDE ON HUMAN HEALTH. (Fukkabutsu ni yoru taiki osen to ningen no kenko). Text in Japanese. Kogai to Taisaku (J. Pollution Control), 6(8):577-582, Aug. 15, 1970. 25 refs.

The health condition of employees under the influence of atmospheri fluoride in an aluminum refinery and the health condition of neighboring residents under the influence of contaminated air from the refinery were surveyed from the viewpoint of epidemiology and clinical toxicology. The people living in the fluoride-bearing atmosphere did not have clear subjective symtoms as to skin and mucous troubles when the fluoride level was between 1.0 and 1.9 ppm. This is quite contrary to the effects of other stimulative gaseous substances like SO2 which is particularly irritating to olfactory organs and skin. Fluoride concentration between 1.0 and 1.9 ppm may cause light obstructive trouble to the pulmonary function but not seriously. The investigation of atmospheric Ht variation and of both tooth spot trouble and osteomalacia, which are representative of chronic fluoride poisoning, has indicated that daily exposure to fluoride-bearing air did not provide any conclusive evidence as to its effect on health as long as the concentration remains between 1.0 and 1.9 ppm. Some dubious aspect in view of clinical toxiology are presented, however. As in the case of the influence of excessive fluoride intake through agricultural products, the direct effect of atmospheric fluoride on respiratory organs is a subject still to be studied.

23563

Cumpston, A. G. and B. D. Dinman

A MODIFIED DIFFUSION METHOD FOR THE DETERMINATION OF URINARY FLUORIDE. Am. Ind. Hyg. Assoc. J., 26(5):461-464, Sept.-Oct. 1965. 7 refs.

A modified diffusion method for the determination of urinary fluoride is described. Forty-eight samples, each with a volume of 0.5 ml, were taken from the same specimen of urine, and increasing quantities of sodium fluoride were added. Twenty-four distilled water blanks were also prepared. Silver perchlorate-perchloric acid solution was added to the urine samples and the distilled water blanks. Diffusion was commenced and allowed to continue for 20 hours at 50 C. After diffusion, measured amounts of sodium fluoride were added to the aqueous extracts of the filter papers from the sample blanks, and absorbances were read on the Beckman DU spectrophotometer, using 1-cm cells. The plot of the absorbance readings was linear for values between 1 and 6 micrograms of added fluoride. Since these represent recoveries from 0.5 ml of urine, they are equivalent to values of 2 to 12 micrograms/ml, a range that would fully meet the requirements of fluoride exposure screening in industry.

23711

Foster, Lloyd L.

EFFECTS OF NITROGEN TRIFLUORIDE ON CARDIOVASCULAR SYSTEM OF RATS. School of Aerospace Medicine, Brooks AFB, Tex., Aerospace Medical Div., Proj. 7753, Task 7753 07, SAM-TR-70-8, 6p., Feb. 1970. 6 refs. CFSTI, DDC: AD 705045

The specific toxicologic action of nitrogen trifluoride, a potential rocket propellant on the cardiovascular system was studied by exposing rats for one minute to tracheal inhalation of the gas. These rats had a definite decrease in diastolic pressure, systolic pressure, and heart rate. Similarly, rats that prebreathe oxygen for 5 minutes before exposure had the same changes in the cardiovascular system as those breathing only NF3. However, animals which inhaled oxygen for 5 minutes immediately after exposure to NF3 showed a temporary increase in diastolic pressure, systolic pressure, and heart rate. It is concluded that NF3 significantly affects the blood pressure and heart rate, and that oxygen alters some of its effects. These effects of NF3 could possibly be attributed to the formation of methemoglobin and myocardial degeneration. Studies by other investigators suggest that contact with NF3 may not only cause anoxemia and damage to the lungs, but harm to the erythrocytes as well. (Author abstract modified)

23763

Call, R. A., D. A. Greenwood, and J. L. Shupe

EFFECT OF ATMOSPHERIC FLUORIDES ON MAN. (FINAL REPORT). Utah State Univ., Logan, Utah Valley Hospital, Provo, Utah State Hospita Provo, NIH, Grants S-83, S-83(C1), and S-83(C?), 71p., 1961 (?). 23 refs.

A report is presented which represents findings from studies designed to obtain information relating to the concentration of fluorides and total particulate matter in the atmosphere under known meteorological conditions in selected industrial and non-industrial areas in Utah, and to determine whether man, living in these areas, has been affected by the fluorides. Average yearly values for fluoride in impinger air samples are reported, and total particulate matter values are also given. Of the 127 human cases studied, 90 came from geographic areas known to have had elevated fluoride levels in the atmosphere and forage. Long-term ingestion of the latter produced changes characteristic of fluorosis in some animals. Analyses for fluoride, calcium, phosphorus, ash, and dry matter were made on various parts of the body. The studies indicate that the levels of fluoride to which Utah residents in these areas had been exposed are not responsible for gross or histologic changes in soft tissue or bone. Chemical and meteorological studies relating to the concentration of fluorides in the atmosphere are described. The medical studies were done on patients ranging in age from infant to 88 years old; their residence in the industrial areas ranged from 0 to 83 years. (Author summary modified)

24126

Collings, Gilbeart H., Jr., Richard B. L. Fleming, and Roy May

ABSORPTION AND EXCRETION OF INHALED FLUORIDES. Arch. Ind. Hyg. Occupational Med., vol. 4:585-590, 1951. 24 refs. (Presented at the American Industrial Hygiene Association, Atlantic City, April 24-26, 1951.)

A study was undertaken to determine the response to inhaled fluorides on the part of two human subjects who had had no previous exposure to significant amounts of fluoride, and who were shown to have normal rates of fluoride excretion in the urine during periods in which they were not subjected to such exposure. As determined by the analysis of serial urine specimens, exposure to atmospheres containing either gaseous fluorides or particulate fluorides produced the same changes in the rate of the urinary excretion of fluorides over a period of time. A single exposure of eight-hour duration to approximately 3.3 mg of gaseous fluorides per cu m of air resulted in an elevation of the rate of urinary excretion of fluorides to approximately 8.1 mg per day; a similar exposure to approximately 5.0 mg of 'insoluble' fluoride dust per cu m of air resulted in an elevation to about 8.9 mg per day. In proportion to the respective atmospheric concentration, the total amount of fluoride excreted after exposure to gaseous fluorides was slightly greater than was the amount excreted after exposure to fluoride dust, but the equal rapidity of urinary changes occasioned by these two types of exposure would indicate that the two forms of fluoride are equally well absorbed by the lungs. Under conditions of usual industrial work in which 8 hours of exposure are followed by 16 hours of freedom from exposure, it is to be expected that the elevation of the rate of urinary fluoride excretion occasioned by the exposure during one work shift will have returned to normal before th next shift begins. (Author conclusions modified)

24153

Autian, John

TOXICOLOGIC ASPECTS OF FLAMMABILITY AND COMBUSTION OF POLYMERIC MATERIALS. J. Fire Flammability, vol. 1:239-268, July 1970. 28 refs. (Presented at Polymer Conference Series, 'Introduction to Flammability and Characteristics of Polymer Materials,' University of Utah College of Engineering, June 15-20, 1970.)

The toxicity problems which may result from the burning or heating of manmade polymeric materials (plastics, elastomers, and textiles) are reviewed at length. After a general discussion of the burning of manmade materials and of toxicology in real fire situations, the effects of some of the more important thermal degradation products are summarized, including carbon monoxide; sulfur dioxide, hydrogen sulfide, hydrogen fluoride, chloride, and cyanide; aliphatic hydrocarbons, aromatic hydrocarbons, nitrogen compounds, and epoxy compounds. Toxic effects from polymer 'fumes' and from smoke are also considered. The literature on laboratory experiments on the toxicity of these products is reviewed, and the need for the development of standardized toxicity testing procedures is stressed. Three levels of toxicity testing are proposed: level I deals with 'life and death' possibilities, level II with toxic effects at sub-lethal concentrations in animals, and level III with ultimate prediction of toxicity on the basis of pertinent data about the degradation products. It is emphasized that, besides the prime attention traditionally accorded to acute toxicity, toxicity consideration must be extended to include possible health effects from lower concentratio of the gases and exposures over longer time periods now that new materials are being used for all types of items, including housing units, and with increasing air pollution from industrial process or from municipal trash incineration. An extensive introduction to toxicology is included as an appendix.

24392

Novakova, Eliska

THE INFLUENCE OF INDUSTRIAL POLLUTION ON ANIMAL COMMUNITIES AND THE USE OF ANIMALS AS BIO-INDICATORS. (Influence des pollutions industrielles sur les communautes animales et utilization des animaux comme bioindicateurs). Air Pollution. Proc. First European Congr. Influence Air Pollution Plants Animals, Wageningen, Netherlands, 1968, p. 41-48. 9 refs. Translated from French. Belov and Associates, Denver, Colo., 11p., Sept. 15, 1970.

Analyses made on blood samples from hares shot during the fall hunting season confirmed the possibility of using hares as indicators of industrial air pollution and of the presence of certain pesticides. The distribution of harmful emissions can be estimated by analyzing some elements of the erythrocytes (hemoglobin, hematocrit, and eventually globular saturation). In general, the blood values decrease with increased pollution, except in a few cases of very high SO2 emissions. The pH of the urine varies: in cement-producing areas, it is over 7.0; in SO2 areas, it is below 7.0. A good practical criterion is the multiplication coefficient calculated from the number of young and full-grown hares killed. For hares in an area of mixed ash and sulfur dioxide pollution, the multiplication coefficient was 30% lower than for controls. In contrast, the coefficient was higher by 35% in an area rich in cement dust. The present investigations, which covered mainly the influence of gaseous SO2 and hydrogen fluoride, point to a decrease in the number of insects (without an actual decrease in the number of species) with increasing pollution. The differences in the taxonomic groups are not pronounced: the decrease in number is almost uniform in all categories. However, a slight increase was noted in the Phytophaga in the most polluted zone and in the Zoophaga in a less polluted zone.

24494

Hagen, Arne R.

NEW VIEWPOINTS ON THE PHYSIOLOGY AND TOXICOLOGY OF FLUORIDES. Nor. Tannlaegeforen Tidsskr., vol. 77:469-486, 1967. 52 refs. Translated from Norwegian. National Institutes of Health, Bethesda Md., Translating Unit, 20p., Oct. 9, 1969.

The change in attitude toward fluorides with respect to their effect on human health is traced over a period of thirty years. From a point where the maximum daily dose of fluorides was established by law at 0.5 mg, medical knowledge concerning the toxicity and physiological reactions of fluorides has progressed to where therapeutic doses of up to 100 mg daily for periods of years can be administered without fear of adverse consequences. In 1963 it was reported (without confirmation) that fluorides in drinking water should increase the frequency of mongoloid births. In 1960, fluorides were reputed to have a serious effect on hormone production. In 1952 they were responsible for loss of hair and lefthandedness. Today they are used in the treatment of osteoporosis and osteogenesis imperfecta. There is mounting evidence indicating they may inhibit calcination of the aorta. The supply of fluorides, especially in childhood years, is an established necessity. Optimum quantities of fluorides create desirable conditions in the bone tissue, and from that point of view, fluoride supply is indicated for adults as well.

24580

FLUORINE GASES IN ATMOSPHERE AS INDUSTRIAL WASTE BLAMED FOR DEATH AND CHRONIC POISONING OF DONORA AND WEBSTER, PA., INHABITANTS. Chem. Eng. News, 26(50):3692, Dec. 1948.

Circumstantial and actual proof was found of acute fluorine poisoning by the smog in the Monongahela River Valley to persons who already had chronic fluorine intoxication according to the official report of investigations of the causes of the death of 17 people in Donora, Pa., and of 3 in Webster. Besides being saturated with soot, the fog blanket also contained sulfur dioxide, carbon monoxide, and hydrofluoric acid. Analysis of blood of deceased and hopitalized victims showed 12 to 25 times the normal quantity of fluorine. Corn crops, very sensitive to fluorine, were severely damaged, and all of the vegetation north of the town was killed.

24720

Linde, Harry W.

ESTIMATION OF SMALL AMOUNTS OF FLUORIDE IN BODY FLUIDS. Anal. Chem., 31(12):2092-2094, Dec. 1959. 10 refs.

The current use of fluorinated organic compounds in medicine makes it desirable to have a method to determine the possible formation of fluoride ion within the body from these compounds. Submicrogram amounts of fluoride ion may be estimated directly in body fluids or water by measuring their inhibitory effect on the enzymatic hydrolysis of ethyl butyrate. In blood or urine, the sensitivity is about 0.1 gamma per ml and in water about 0.1 gamma per 100 ml. The reproducibility is about 0.1 to 0.2 gamma. The procedure is useful for determining fluoride ion in the presence of compounds containing fluorine in nonlabile organic combination, as it does not require sample ashing, which might decompose these compounds. Substances which interfere with enzyme activity or which are excessively buffered will interfere with the method. (Author abstract modified)

25160

Mohamed, Aly H.

INDUCED RECESSIVE LETHALS IN SECOND CHROMOSOMES OF DROSOPHILA MELANOGASTER BY HYDROGEN FLUORIDE. Preprint, International Union of Air Pollution Prevention Associations, 11p., 1970. 13 refs. (Presented at the International Clean Air Congress, 2nd, Washington, D. C., Dec. 6-11, 1970, Paper MB-4F.)

Drosophila melanogaster, the fruit fly, males of the genotype plus b/dp plus were fumigated with hydrogen fluoride in population cages. The source of HF was a 2.5% concentration of hydrofluoric acid. The fumigation period was for a total of 12 hr, with the first treatment being for 6 hr, followed by increments of 3 hr, giving a total of three treatment durations. Control runs were always made simultaneously with treatment periods. Double distilled water was substituted for the hydrofluoric acid in the control. After each treatment period, the fumigated males, as well as the control males, were mated singly with virgin females of the tester stock Cy/Pm dp b (chromosome 2). The offspring from the crosses Pm dp plus/Pm dp plus or Pm plus b/Pm plus b were classified to determine the presence of lethal second chromosomes. The data indicated that HF was able to reduce the viability of homozygotes for all the treatments. The average viability was 26.16% while the expected normal should have been 33.3%. The differences among the three treatments indicated that HF has a cumulative effect. There was a trend toward a higher frequency of lethal and semilethal chromosomes (drastics) with an increase in treatment duration. It can be concluded that HF is a mutagenic agent. (Author abstract)

25469

Waldbott, G. L.

CHRONIC FLUORIDE INTOXICATION DUE TO AIR POLLUTION. Preprint, International Union of Pollution Prevention Associations, 20p., 1970. 13 refs. (Presented at the International Clean Air Congress, 2nd, Washington, D. C., Dec. 6-11, 1970, Paper MB-4D.)

In view of the sparsity of data on neighborhood fluorosis, clinical observations are presented on 32 individuals afflicted with 'neighborhood' fluorosis in the pre-skeletal phase. Twenty- eight had been residing within three miles of an Ontario fertilizer factory, 3 near two Iowa fertilizer factories, and one in the vicinity of a Michigan iron foundry. In all cases characteristic fluoride damage to plants, livestock, and materials was established General malaise and exhaustion leading to complete disability characterizes the disease. All except two boys reported pain and stiffness in the lumbar and cervical spine, with restriction of spinal movements and arthritis in other joints. Myalgia and paresthesia were complained of, as well as impaired muscular power. Bilateral migraine-like headaches were encountered in 20 of the patients, while 10 patients complained of visual disturbances. Eighteen individuals had gastrointestinal disturbances and 10 had skin lesions. Nasal and conjunctival irritation was common, and 6 patients had a history of frequent epistaxis. In the hospitalized cases, the spinal x-rays showed changes indicative of osteoarthritis. Hypercalcemia, hyperuricemia, polyuria, a rise in alkaline phosphatase, and a slight impairment of liver function were noted but were not sufficiently consistent to be attributed to chronic fluoride intoxication. A typical case report is included.

25946

Smith, Frank A., Dwight E. Gardner, Nicholas C. Leone, and Harold C. Hodge

THE EFFECTS OF THE ABSORPTION OF FLUORIDE. V. THE CHEMICAL DETERMINATION OF FLUORIDE IN HUMAN SOFT TISSUES FOLLOWING PROLONGED INGESTION OF FLUORIDE AT VARIOUS LEVELS. A.M.A. Arch. Ind. Health, 21(4):330-332, April 1960. 2 refs.

Fluoride levels were determined in human heart, liver, lung, kidney, spleen, and aorta taken from 23 autopsies. With the exception of the aorta, no tissue had accumulated fluoride to any degree, and there was no indication of fluoride increasing with increasing concentration of fluoride in water. The levels of concentration of fluoride in the aorta correlated well with age; the concentration increased with increasing age. The increase of fluoride in the aorta with age may be associated with the increase in calcification in this tissue with advancing age.

26274

Lohs, Karlheinz

TASKS AND PROBLEMS OF INDUSTRIAL TOXICOLOGY FROM THE VIEWPOINT OF TECHNICAL CHEMISTRY. (Aufgaben und Probleme der Industrietoxikologie aus der Sicht der technischen Chemie). Text in German. Chem. Tech. (Berlin), 17(1):38-41, Jan. 1, 1965.

Industrial toxicology faces two complexes of problems. The first are problems arising from the manufacture and processing of toxic raw, intermediary, and primary materials; the second

complex encompasses problems which the manufacturing process poses for the biosphere. Hydrocyanic acid, tetraethyl lead, and some very toxic insecticides (organic derivatives of phosphoric acid) are examples of the first category. While industrial analytical instruments working on the principle of chemical reactions or their physical manifestations have an accuracy of around 0.1 ppm, some toxicologically dangerous chemicals require a detection accuracy of the order of 0.001 ppm which requires biochemical and biophysical detection methods. Another problem are the periodic clinical checkups of employees because in some cases toxic manifestations have appeared in the form of secondary manifestation without acute symptoms. Lack of knowledge and information complicates the setting up and enforcement of hygienic norms. Toxic emissions posing problems are industrial dusts, ash and smoke oxides of sulfur and of nitrogen, hydrocarbons, aldehydes, acids, ammonia, tars, ketones, peroxides, nitroolefines, and carbon monoxide. Catastrophies caused by smog are known from Europe as well as from North America when aerosol concentrations reached levels exceeding 2 mg/cu m as against the 100 microg/cu m level of normal industrial pollution. The London smog is as a result of high humidity characterized by a high content of sulfur trioxide in addition to sulfur dioxide, a highly irritating combination. The most toxic component of photochemical smog resulting from the action of ultraviolet irradiation on smog is peroxyacetyl nitrate which is highly toxic to humans and plants at very low concentrations. Other problems are exemplified by fluoride dusts and emanations from the manufacture of polyethylene.

26461

Largent, Edward J.

THE METABOLISM OF FLUORIDES IN MAN. A.M.A. Arch. Ind. Health, 21(4):318-323, April 1960. 8 refs.

The balance between the intake and output of fluoride was investigated with three healthy adults. Fluoride absorption from the alimentary tract was remarkably effective, while roughly half of the fluoride salts were excreted in the urine. Approximate balance between the intake and output of fluoride was achieved at levels ranging from 0.4 to 0.8 mg per day. When the skeleton approaches saturation with fluoride at a given level of absorption, the rate of accumulation therein diminishes progressively as the absorption at the rate continues. Excretion of fluoride in sweat was a highly significant feature of the fluoride metabolism in hot weather. In another experiment, those subjects whose intake of fluoride in drinking water had been high for long periods of time, had accumulated abnormal quantities of fluoride in their tissues. Subjects who were subjected to the inhalation of air containing hydrogen fluoride experienced a slight stinging sensation in the skin of the face and in the eyes, as well as some slight irritation of the nasal passages. A much greater excretion of fluoride in the urine was observed, but an explanation was not found for the unexpected increase in fecal elimination.

26743

McCann, H. G.

THE EFFECTS OF THE ABSORPTION OF FLUORIDE. VII. COMPARISON OF THE PHYSIOLOGIC AND PATHOLOGIC CHARACTERISTICS AND OF THE FLUORIDE CONTENT OF THE SKELETAL TISSUES OF TWO PERSONS OF SIMILAR EXPERIENCE, EXCEPT FOR EXPOSURE TO FLUORIDE: PART 2. THE FLUORIDE CONTENT OF THE SKELETAL TISSUES. A.M.A. Arch. Ind. Health, 21(4):336-337, April 1960.

The fluoride content was determined in selected dry, fat-free identical specimens of bone from the bodies of two human females. One of the two persons had been a continuous resident of Washington, D. C. for 25 years, during which time the fluoride content of the water had been 0.2 ppm; the other had been a resident of Bartlett, Texas continuously for 34 years, during which time the fluoride content of the water was 8 ppm. The quantities of ash, calcium, phosphorus, magnesium, and carbon dioxide were also determined, to throw some light on the effect of the deposition of fluoride on those constituents of bone particularly concerned with calcification. The average percentage of ash in the bones of subject B was 64.91, as compared to 57.71 in those of Subject A. The calcium of subject B was elevated to 24.16% as compared to 21.72%, and the phosphorus in the same sequence was 10.55% as compared to 9.74%. Some increased calcification evidently has occurred in the skeletal tissues of subject B in association with her relatively high intake of fluoride in water. The histological, x-ray, historical, and clinical data obtained prior to death from the examination of subject B failed to reveal any skeletal abnormalities or systemic conditions of consequence to health or well-being that could be attributed to the absorption of fluoride, in spite of the fact that at autopsy the skeletal tissues showed a remarkably high fluoride content.

26846

Tsunoda, Fumio

NEW ASPECTS OF AIR POLLUTION PROBLEMS: SPECIAL REFERENCE TO FLUORIDES. (Taiki osen mondai no arata naich: kyokumen - fukkabutsu ni yoru baai o rei ni). Text in Japanese. Igaku No Ayumi (Progr. Med.), 70(13):621-623, Sept. 1969. 2 refs.

Fluorine in air pollution mainly originates from aluminum refineries, phosphate fertilizer factories, and ceramic industries. Fluorides have a strong toxicity against plants and tend to become accumulated in them. For example, in the western mountain areas of Fukushima Prefecture, silk production has been destroyed due to damages to mulberry trees since the establishment of an aluminum refinery plant in the area. The process involves the use of 3NaF-AlF3. An epidemiological investigation was conducted on pollution by fluorides, and the subjects chosen for this purpose were 35 to 54- year old farm workers exposed for a long time to hig concentrations of fluorides in air. The items examined were the determination of fluorine in urine, pulmonary function, existence of effects on teeth, and hardening of bones. Although it will take a long time to get any results from the investigation, it is also necessary to evaluate the effects of fluoride pollution in water, soil, and food.

26873

Farrah, George H.

DIFFUSION METHOD FOR DETERMINATION OF URINARY FLUORIDE: RECENT DEVELOPMENTS. Am. Ind. Hyg. Assoc. J., 25(1):55-58, Jan.-Feb. 1964 13 refs. (Presented at the American Industrial Hygiene Association Annual Meeting, Cincinnati, Ohio, May 9, 1963.)

The determination of urinary fluoride, as an indication of fluoride exposure, has been greatly simplified by the microdiffusion-colorimetric technique. Problems that have been reported in the use of this method generally involve either high blanks or low recovery from standards and spiked samples. Where highest accuracy is needed, cleaning of each diffusion dish with hot acid solution, followed by a distilled water rinse may be helpful. Random low recovery is apparently associated with poor distribution of dried caustic on the lid of the diffu-

sion dish, and the most satisfactory remedy has been an increase in alcoholic concentration to about 80%, and doubling of the caustic concentration to 1 N. Experience in diffusion of several duplicate sets of urine samples with sulfuric acid and with perchloric acid has shown slightly higher recoveries with the latter. However, some may prefer to use sulfuric acid because of the safety precautions generally required for the storage and handling of perchloric acid. Where maximum accuracy and precision are necessary for determinations of low microgram or fractional microgram quantities of fluoride, the lanthanum chelate of alizarin complexone is the reagent of choice. For industrial hygiene work, the zirconiumeriochrome cyanine R reagent is preferred.

27379

Stokinger, Herbert E.

EFFECTS OF AIR POLLUTION ON ANIMALS. In: Air Pollution. Arthur C. Stern (ed.), Vol. 1, New York, Academic Press, 1962, Chapt. 9, p. 282-334. 122 refs.

Experimental investigations designed specifically to determine the effects of air pollutants on animals have been undertaken only recently, whereas field studies have been made sporadically for many years. The goal of the field studies has been to find the etiologic agent of some local affection in domestic or wild animals while the aim of the laboratory studies has been to determine whether a health hazard exists for man. Air pollution episodes and the acute effects on domestic animals and animals in captivity are discussed, as well as the chronic poisoning of livestock and wild animals. Chronic effects are confined to arsenic, lead, molybderum and fluoride. Laboratory studies are cited on the effects of engin exhausts, the bactericidal action of oxidant smog, simulated oxidant smogs, and ultraviolet irradiated gasoline-nitrogen oxide mixtures. The acute toxicity of ozone is reviewed, including the effects of age, intermittent exposure, disease, exercise, temperature, reducing agents and drugs. Development of a tolerance to ozone is indicated. Subchronic toxicity is mentioned, as well as the characterization of ozone injury, chronic fibrosis of the lung, and ozone as a lung tumor accelerator. The effects of nitrogen dioxide, nitric oxide, and nitrogen pentoxide are discussed. Information on the toxicological effects of sulfur dioxide, ammonia, and carbon monoxide is also presented. Sulfur trioxide and sulfuric acid mists are considered, as well as oil mists. Organic vapors which are discussed include formaldehyde and its homologues, ketones, ketenes, organic hydroperoxides and peroxides, organic sulfur compounds from petroleum, and the conjugated nitro olefins. The study of toxicological interactions among various air pollutants has also demonstrated important instances of both synergism and antagonism. Effects of mixtures of particulate with gas or vapor are reviewed, as well as oil mists and oxidant gases, and beryllium sulfate mist and hydrogen fluoride vapor. Mixtures of gases and vapors which are considered include ozone and hydrogen peroxide, ozone and 100% oxygen, ozone and carbon dioxide, ozone and nitrogen dioxide, carbon monoxide and gaseous synergists, and sulfur compounds and oxidant gases.

27753

Talvitie, N. A. and Lial W. Brewer

SEPARATION OF FLUORIDE BY ION EXCHANGE: APPLICATION TO URINE ANALYSIS. Am. Ind. Hyg. Assoc., J., 21(4):287-295, Aug. 1960. 15 refs. (Presented at the American Industrial Hygiene Assoc. Annual Meeting, 21st, Rochester, N. Y., April 25-28, 1960.)

Two ion-exchange procedures are described which provide simple, low-cost alternatives to the distillation process for the separation of fluoride from urine. The first procedure involves the elution of fluoride from hydroxide resin with hydroxide ion, the second the elution of fluoride from acetate resin with beryllium ion. The results obtained with the first procedure are i close agreement with those obtained by distillation, while the results obtained with the second procedure are consistently higher than those for distillation. Both methods permit the simultaneous processing of a large number of samples and the attainment of an over-all rapidity of analysis. Because the second procedure has a low level of background interference, it is particularly suitable for evaluating control measures for protecting industrial populations in which the fluoride excretion level at times exceeds tenfold the normal.

27755

Rowley, R. J. and G. H. Farrah

DIFFUSION METHOD FOR DETERMINATION OF URINARY FLUORIDE. Am. Ind. Hyg. Assoc., J., 23(4):314-318, July-Aug. 1962. 8 refs. (Presented at the Pittsburgh Conference on Analytical Chemistry and Applied Spectroscopy, Pittsburgh, Pa., March 5, 1962.)

A modified diffusion procedure is presented for analyzing urinary fluoride. No preliminary treatment is required and operator time i greatly reduced since samples can be conveniently processed in larg groups. A 1 ml portion of specimen is placed in a plastic Petri dish containing a chloride fixative. The sample is acidified and the dish closed with a cover coated on the inner surface with sodiu hydroxide. After diffusion for 20 hrs at 50 C, fluoride in the caustic film is colorimetrically measured by the Thorium-Alizarin Red S method or the Zirconium-Eriochrome Cyanine R method. Absorbance of fluoride against water is then determined spectrophotometrically at a wave length of 525 micrometers. Conversion to micrograms of fluoride is made by means of a corresponding calibration curve. Within the range 0-25 micrograms F/ml the precision and accuracy of this method are comparable to those of the distillation procedure. (Author abstract modified)

27895

Boysen, John E.

HEALTH HAZARDS OF SELECTED ROCKET PROPELLANTS. Arch. Environ. Health, vol. 7:71-75, July 1963. 2 refs.

Many of the present day propellants and oxidizers present unusual problems because of their high order of toxicity and the huge quantities used. The current 'concept of concurrency' also creates additional problems because design and procedural decisions must be made before the development of adequate toxicological and clinical data. Design of toxicological experiments is discussed, including the basis for threshold limit values. During the course of experimentation and clinical observation, efforts are made to determine the mechanisms of toxic stress as well as to find the early indicators of response to toxic agents. Indicators of physiological or pathological change are mentioned. Evaluation of the operational risk which is involved in the transport, storage, and firing of rocket propellants is a problem of considerable magnitude. The design of a medical program involving the use of propellants must also include periodic examinations and the treatment of casualties. Symptoms are mentioned due to exposure to unsymmetrical dimethylhydrazine, pentoborane, nitrogen tetroxide, chlorine trifluoride, perchloryl fluoride, and n-propyl nitrate.

28019

Rosenzweig, Kurt A. and I. Abkewitz

PREVALENCE OF ENDEMIC FLUOROSIS IN ISRAEL AT MEDIUM FLUORIDE CONCENTRATION. Public Health Rept. (U. S.), 78(1):77-80, Jan. 1963. 15 refs.

Examination of 262 children in Qiryat Haiyim, a suburb of Haifa, Israel, revealed the presence of endemic fluorosis. Local water contains about 0.75 ppm fluoride, the optimum level according to the formula of Galagan and Vermillion. Fluorosis was less prevalent and caries experience slightly but consistently higher in both sexes and at all ages in children who had been absent from Qiryat Haiyim for a continuous period of at least one month, but the mean decayed, missing, and filled teeth (DMF) of all age groups was within the limits observed in the major cities of the country. Climatic conditions which increase intake of water, as well as fluorides in seafood and tea, may be the cause of the endemic fluorosis. The slightly increased protection against caries does not justify the observed amount of fluorosis. (Author conclusions modified)

28037

Marier, J. R., Dyson Rose, and M. Boulet

ACCUMULATION OF SKELETAL FLUORIDE AND ITS IMPLICATIONS. Arch. Environ. Health, 6(5):664-671, May 1963. 71 refs.

Absorption of fluoride and various effects of its accumulation are discussed. When inorganic fluoride is ingested at any concentration, a portion of it is deposited in the skeletal structure of animals or man. The amount deposited has been found to be a fairly consistent function of the amount absorbed from the digestive tract; however, the rate of fluoride deposition in bone tends to decrease gradually with time. The concomitant ingestion of multivalent cations, especially in the presence of phosphate, promotes formation of insoluble fluoride aggregates in the digestive tract, favoring fecal excretion of ingested fluoride. Deposition of fluoride in bones and teeth probably occurs by means of an exchange of fluoride for hydroxyl and bicarbonate ions at the crystal surface of bone mineral. Incorporation of fluoride is discussed, including surface exchange. Fluoride deposition occurs most intensely in skeletal areas of high metabolic activity or grea vascularity so that cancellous bone tends to accumulate more fluoride than does cortical bone. Incorporation of even small amounts of fluoride into bone and tooth minerals causes a substantial reduction in solubility; the effect is proportional to the degree of fluoride incorporation, i.e., it is dependent on the proportion of hydroxyapatite converted to the less soluble fluoroapatite. Pathological changes in bone associated with fluoride accumulation are discussed. Fluoride is incorporated into teeth by the same ion-exchange mechanism involved in bone, although the rate of migration of fluoride from the crystal surface to the interior of the enamel is much slower. Recommendations are presented for further research.

28041

Carpenter, Frank G.

ANESTHETIC ACTION OF INERT AND UNREACTIVE GASES ON INTACT ANIMALS AND ISOLATED TISSUES. Am. JPhysiol., vol. 178:505-509, Sept. 1954. 22 refs.

To measure the depressant effect of inert gases relative to one another, the pressure required of each to protect 50% of a group of mice from electroshock convulsions was determined. Twenty to thirty animals were tested at five different pressures of each gas and the results plotted with respect to the percentage protection afforded on logarithmic probability paper. The gases included cyclopropane, dichlorodifluoromethane, ethylene, xenon, nitrous oxide, krypton, sulfur hexafluoride, methane, argon, nitrogen, and helium. Sciatic nerves from adult albino rats weighing 300-400 grams were dissected, and the effect of these gases was measured by the decrease in excitability, blockade of fiber conduction, and alteration in the polarized state of the constituent fiber membrane. At consistently higher pressures six out of seven of the gases tested diminished excitability, blocked conduction, and produced significant depolarization of isolated rat peripheral nerve. The depressant action of these substances is fundamentally related to the facility with which they dissolve in olive oil or a non-polar liquid to produce a critical concentration of molecules at their site of action. The relative solubility of a gas in olive oil or a non-polar liquid is inversely proportional to its standard state fugacity. For two gases of very high molecular weight, smaller amounts were dissolved than would be predicted by this rule and the relation between the depressant action of a gas and its fugacity is not so clear. (Author summary modified)

28139

Mangold, C. A. and R. R. Beckett

COMBINED OCCUPATIONAL EXPOSURE OF SILVER BRAZERS TO CADMIUM OXIDE, NITROGEN DIOXIDE AND FLUORIDES AT A NAVAL SHIPYARD. Am. Ind. Hyg. Assoc. J., 32(2):115-118, Feb. 1971. 15 refs. (Presented at the American Industrial Hygiene Association, Annual Meeting, Bremerton, Wash., Oct. 2-3, 1969.)

Silver brazers at the Puget Sound Naval Shipyard are chronically exposed to cadmium oxide fume, nitrogen dioxide gas, and fluorides during the assembly of copper, or copper alloy piping aboard ships under construction and repair, and in the pipe shop. Physiological effects of exposures to the toxic gases and fumes produced by silver brazing are cited. While the intermittent peak exposures occurring during the heating cycle often are above the current Threshold Limit Values, the time-weighted average exposure do not exceed the combined threshold limits calculated on the basis of additive effects. The combined occupational exposures to CdO, NO2, and fluorides may occur during an acute exposure, but most likely the effects are due to nitrogen dioxide, since most of the solders in use do not contain cadmium. Since both cadmium oxide fume and nitrogen dioxide gas produce a delayed pulmonary response, acute inhalation cases involving silver brazers might be attributed to cadmium oxide fume, when nitrogen dioxide is the cause. (Author abstract modified)

28199

Stokinger, H. E.

TOXICOLOGY OF CHEMICAL AIR POLLUTANTS. Chem. Can., 5(1):23-26, 36, 44, Jan. 1953. 37 refs.

A brief summary of available semi-quantitative information on the major group constituents of industrial atmospheres, concentration of metallic elements in urban atmospheres, and concentrations of elements by type of urban district is presented in table form. Distinct seasonal variations are noted. Bodily intake of solid particles (and possibly of oil droplets as well) is affected primarily by particle size, especially for insoluble particles, whereas solubility governs the amount of gases and vapors retained in the body. The volume of air inhaled is affected by type of physical activity. Once inhaled, the behavior of inorganic substances in the body depends on whether the metal salts remain in solution in ionic dimensions, or whether they precipitate to colloidal forms. The former are distributed

uniformly to all body tissues and then are uniformly deposited in bone; the latter are entrained to certain organs (e.g., liver, spleen) or deposited in bone in spotty distribution. The toxicologic effects of certain chemical air pollutants are reviewed sulfur dioxide, sulfur trioxide, hydrogen fluoride, and sulfuric acid mist; arsenic and arsine; smog ingredients; beryllium; cadmium; and fluorine and its compounds.

28429

Stokinger, Herbert E.

AIR POLLUTION AND THE PARTICLE SIZE-TOXICITY PROBLEM--1. Nucleonics, 5(6):50-62, Dec. 1949. 15 refs.

Industrial air pollution problems are discussed in the context of community air pollution and in-plant pollution. Special attention is given to airborne beryllium concentrations producing clinical disease within a 1/4 mi radius of a beryllium plant, to recent developments in identifying toxic agents in plants, and to particle characteristics responsible for toxic hazards. Cases of beryllium poisoning, some fatal, were caused by environmental beryllium concentrations as low as 0.1-0.01 microgram/cu m air. The toxicity of various grades of beryllium oxides increases with increased surface area, which is associated with increased solubility but not necessarily with particle size. Industrial beryllium poisoning is enhanced by hydrogen fluoride and physical exercise though, unlike silicosis, not by tuberculosis. Two major sites of possible radiation injury from long-term inhalation of uranium dust in very low concentrations are the lungs, from accumulation of insoluble uranium compounds, and bones, chiefly through accumulation of soluble uranium compounds. Lung retention of the insoluble dusts is greatly influenced by particle size.

28556

Adler, P., W. D. Armstrong, Muriel E. Bell, B. R. Bhussry, W. Buettner, H. D. Cremer. V. Demole, Y. Ericson, I. Gedalia, H. C. Hodge, G. N. Jenkins, S. S. Jolly, E. J. Largent, N. C. Leone, T. G. Ludwig, A. E. Martin, G. Minoguchi, J. C. Muhler, E. R. Schlesinger, A. H. Siddiqui, L. Singer, A. Singh, F. A. Smith, G. K. Stookey, D. R. Taves, P. Venkateswarlu, J. C. Weatherell, S. M. Weidmann, and I. Zipkin

FLUORIDES AND HUMAN HEALTH. (Fluoride und menschliche Gesundheit). Text in German. Oeffentl. Gesundheitswesen (Stuttgart), 33(3):173- 182, 1971. 3 refs.

Fluorides present in atmospheric dust and gases are an important health hazard, since fluoride ions are almost completely retained in the lung. The world consumption of calcium fluoride (for steel production and other purposes) amounts to more than 2 million tons per year. Several times 200,000 tons of CaF2 are produced in the United States alone. Since long-term exposure to high fluorine concentrations is harmful, elimination by the body is of importance. Fluorides are eliminated by the feces, urine, sweat, and in small quqntities by skin. Most of the fluorine is discharged with the urine. A long-term intake of more than 2 to 8 mg/day fluoride causes abnormal density of bones.

28754

Tsuji, Yoshihito and H. Tsunoda

AN EPIDEMIOLOGICAL SURVEY ON THE HUMAN EFFECTS OF FLUORIDE AIR POLLUTION IN KITAKATA, FUKUSHIMA PREF. IN JAPAN. (Fukkabutsu ni yoru taiki osen no seitai ni oyobosu eikyo ni tsuite no ekigaku chosa. Kitakata-shi no baai). Text in Japanese. Taiki Osen Kenkyu (J. Japan Soc. Air Pollution), 5(1): 145, 1970. (Proceedings of the Japan Society of Air Pollution, Annual Meeting, 11th, 1970.)

An epidemiological study was conducted on the relationship between contamination of air by fluorides emitted from an aluminum refining factory and the health of adults permanently residing in the area. The subjects were residents, aged 35-64 yrs, in the polluted village and of a control village. Subjective symptoms of fluoride poisoning, bone x-rays, cardiac and pulmonary functions, blood characteristics, and fluoride content of urine were studied. 'Discomfort' was obviously more frequent among men and women of the polluted area, but there was little difference between the two villages with respect to irritation of skin and eyes and pain in the joints. Results of pulmonary and cardiac function tests were also similar. Bone x-rays showed that osteosclerosis was relatively more frequent in the polluted area only for knee joints. As far as blood characteristics were concerned, there were no abnormal findings in either village. Urine fluoride levels were higher among men in the polluted area, but the concentrations were ion concentrations and the measurements were made only over a short period. Thus no conclusive statements could be made as to the effects of fluorine on the urine of the residents.

29043

Osaka Prefecture (Japan), Suita Public Health Center

REPORT ON THE SURVEY ON EFFECTS OF POLLUTION OF LIVING ENVIRONMENT- SURVEY OF POLLUTION FROM MORITA CHEMICAL CO., LTD. IN SOUTHERN SUITA CITY. (Seikatsu kankyo osen eikyo chosa hokoku - minami fukita chiku ni okeru morita kagaku kogyo kabushiki kaishi kogai ni kansuru jintai eikyo chosa). Text in Japanese. 48p, July 1970.

On Aug. 27, 1969, a newspaper reported that about 18 hectares of paddy field rice died because of the effect of hydrogen fluoride in the neighborhood of a chemical company. An investigation revealed that large amounts of HF were emitted during a power failure on the night of July 3, 1969. The chemical company's major products are hydrofluoric acid and aluminum fluoride. Damage to farm land, agricultural products, trees, and tin-plated iron sheet roofing from HF was repeated yearly despite the expansion of production at the factory and their efforts to improve the situation. Between September 1960 and October 1967 there were 15 disputed cases between the residents and the factory. The maximum fluorine concentration detected was 0.059 mg/cu m and the average concentration was was 0.016 mg/cu m in the plot next to the factory. A medical survey showed symptoms such as cough, phlegm, nausea, and throat irritation in people who stayed home. The same sort of respiratory disturbances were observed in the other similar areas. Fifty-nine percent of the people were over 40 years old. No clear-cut effects were observed ophthalmologically and otorlaryngologically. Among infants, a high ratio of reddish pharynx and an abnormal respiratory sound were observed. It was concluded that at present concentrations there are no immediate and serious effects anticipated, but since the pollution is expected to continue in the future, immediate steps should be taken.

29415

Fukushima Prefectural Government (Japan)

INVESTIGATION OF EFFECT OF FLUORIDE ON HUMAN BODY. (Fukkabutsu no jintai ni oyobosu eikyochosa). Text in Japanese. 66p., 1970.

The effect of fluorides exhausted from aluminum smelters over a score of years was investigated on 35 to 64 year-old residents of either a polluted area (A) in Kitakata city, Fukushima prefecture, or a control area (B) in the suburbs of Kitakata city. One hundred and forty-three residents of A area and 135 residents of B area took medical advice. Geometric

average values in the air were 1186.2 micrograms of fluoride in A area and 39.7 in B area. Tests were carried out on the existence of subjective symptoms. The medical history of fractures, mottled enamel, and swelling of the thyroid gland, bone radioscopy, electrocardiogram, lung ventilative function, the determinations of serum transaminase alkaline phosphatase, calcium, inorganic phosphorus, hematocrit value and the quantity of hemoglobin, urinary protein, urobirinogenen, sugar, and the quantity of fluorine in urine. These results were studied by area, sex, the number of years of residence, profession, and the toxicological effects. Excess intake of fluoride was not found to cause harm either in groups or in individuals. But the averages of the quantity of fluorine in urine were 0.88 ppm (male) and 0.70 ppm (female) in A area; both males and females were 0.47 ppm, in B area; this is the only point which differed for the two areas. X-ray investigation showed fair numbers of osteosclerosis, but these were not certified to have resulted from fluorine.

29807

American Industrial Hygiene Assoc., Detroit Mich., Biochemical Assay Committee

BIOLOGICAL MONITORING GUIDES. FLUORIDES. Am. Ind. Hyg. Assoc. J., 32(4):274-279, April 1971. 26 refs.

The nature of industrial exposures to fluorides is indicated and the metabolic fate of fluoride absorbed by the worker is briefly reviewed. Industrial exposure to these compounds may be assessed by measurement of the urinary excretion of fluoride, and urinary levels encountered in personnel in several fluoride-using industries are reported. Such data can be of use in arriving at approximations of the magnitude of exposure of a work force, and to indicate whether or not deleterious effects may be produced. The long term hazard to be protected against in the course of industrial exposure to fluorides is the development of crippling fluorosis. If early osteosclerosis as evidenced by increased density to x-rays can be avoided, crippling fluorosis will not be seen. Urinary fluoride concentrations not exceeding 5 mg/liter in before-shift, spot samples taken after two days off work are not associated with osteosclerosis, and such changes are unlikely at urinary levels of 5 to 8 mg/liter. (Author summary modified)

30145

Weigand, Walter

STUDIES OF THE INHALATION TOXICITY OF THE FLUORINE DERIVATIVES OF THE METHANE, ETHANE AND CYCLOBUTANE. (Untersuchungen ueber die Inhalationstoxizitaet von Fluorderivaten des Methan, Aethan und Cyclobutan). Text in German. Zbl. Arbeitsmed., 21(5):149-156, 1971. 10 refs.

Acute and chronic inhalation tests were performed on rats, guinea pigs, cats, and beagles with chlorotrifluoromethane ($CClF_3$), chlorodifluoromethane ($CHClF_2$), bromochlorodifluoromethane ($CBrClF_2$), 1-chloro-1, 1-2,2,2-pentafluoroethane ($CClF_2$-CF_3), carbon fluoride (C_4F_8,). and dichlorofluoromethane ($CHCl_2F$). The acute inhalation tests (one exposure for two hours) on rats and guinea pigs showed that $CClF_3$, $CClF_2$-CF_3, and C_4F_8 caused no injuries even when a dose of 60% by volume was inhaled. Chlorodifluoromethane caused no injuries in rats to a concentration of 2.5% by volume and in guinea pigs to five percent. The limit concentration for $CBrClF_2$ was five percent by volume for rats and 10% for guinea pigs. For $CHCl_2F$, the limit concentration was one percent by volume. In the chronic experiments, the animals were exposed to the fluorine derivative/air mixture five days a week for three and one half hours per day. The experiments lasted four weeks. The total inhalation time was 70 hours. The concentrations ranged from 20% by volume for $CClF_3$, $CClF_2$-CF_3, and C_4F_8 to between 2.5 and 7.5% by volume for $CBrClF_2$. With the exception of $CHCl_2F$ and $CBrClF_2$, no injuries were caused by the fluorine derivatives. None of the derivatives attacked the respiratory tract.

30183

Tajima, Yoshio, Kyoko Shinohara, Hideo Kinebuchi, and Toru Yamauchi

THE INFLUENCES OF ATMOSPHERIC FLUORIC FLUORIDE POLLUTION UPON THE SKELETAL DEVELOPMENT OF SCHOOL CHILDREN. (Fukkabutsu no yoru taikiosen ga gakudo no kotsu seijuku ni oyobosu eikyo). Text in Japanese. Fukushima Igaku Zasshi (Fukushima Med. J.), 18(5-6): 185-189, Dec. 1968. 16 refs.

In K city, Fukushima Prefecture, the skeletal development of 506 boys and girls in the 5th, 6th, 8th, and 9th grades was examined by x-rays of their right arms. A region within two km from the aluminum refinery, polluted with fluoride (three to five ppb fluoride and 100 to 230 kg/sq km/month fluorine per atmospheric dust fall), and a town only slightly polluted by fluoride located six km away from the refinery were studied. The x-rays were classified according to the standard of the skeletal development determined by Greulich and Pyle. Comparative studies on region, sex, and school year were also done. Children in the polluted area were found a little behind in the development of carpal bones in the 5th and 6th grade and metacarpal and digital phalanx bones in the 6th grade. Low levels of fluorine in the air promote the skeletal development of 8 - 12 year old school children; however, in this study, such a tendency was not found. Such a tendency was found however, in the girls in the 8th and 9th grade in the junior high school in the polluted area. Thus, if fluorine had an influence upon the skeletal development, the influence is greater upon the smaller children, and varies according to the individual child. There was only a slight difference between the polluted area and non-polluted area. Therefore, pollution in this area does not have a serious influence upon the skeletal development of children.

30385

Gerdes, Raymond A., James D. Smith, and Howard G. Applegate

THE EFFECTS OF ATMOSPHERIC HYDROGEN FLUORIDE UPON DROSOPHILA MEIANOGASTER - II. FECUNDITY, HATCHABILITY, AND FERTILITY. Atmos. Environ. (London), 5(3):117-122, March 1971. 2 refs.

Two strains of Drosophila melanogaster were treated with sublethal levels of gaseous hydrogen fluoride for six weeks. Egg samples were collected at various times for hatchability determinations. Adults reared from these samples were evaluated for fecundity and fertility. Treatment with HF caused a marked reduction in hatchability and fecundity in the more sensitive strain. Male fertility was depressed, but female fertility remained stable over the test period. The reduction of these parameters in the offspring of populations subjected to low levels of atmospheric HF pollution for prolonged periods suggests that HF causes genetic damage. (Author abstract modified)

30387

Gerdes, Raymond A., James D. Smith, and Howard G. Applegate

THE EFFECTS OF ATMOSPHERIC HYDROGEN FLUORIDE UPON DROSOPHILA MELANOGASTER - I. DIFFERENTIAL GENOTYPIC RESPONSE. Atmos. Environ. (London), 5(3):113-116, March 1971. 4 refs.

Four inbred lines of Drosophila melanogaster were exposed to various concentrations of gaseous hydrogen fluoride for a period of six weeks. At all treatment levels the populations responded similarly during the first 12 hours with few deaths occurring. However, during the second 12 hours it was apparent tht the 5.5 ppm HF level was harmful. By the end of the third day all flies subjected to this treatment were dead. At 4.2 ppm a definite difference in the response of the different strains existed. A different mechanism is involved with the three reduced concentrations than that displayed at 5.5 ppm. At the higher concentration a directly deleterious effect is noted, while at the reduced levels a genetic effect is indicated by the different genotypic responses. The effects on viability were predominantly linear with respect to fluoride concentration over the ranges tested. The differential responses of the inbred lines were interpreted to mean that tolerance to fluoride contamination is influenced by genotype. (Author abstract modified)

30788

Fournier, P.

AIR POLLUTION AND ITS ROLE IN RESPIRATORY PATHOLOGY. (Les pollutions atmospheriques et leur role en pathologie respiratoire). Text in French. Sem. Ther., 47(4):395-398, April 1971.

The sources of air pollution are manifold: fumes from domestic and industrial combustion, industrial residues, exhaust gases from automotive vehicles, dust generated by road traffic, and the always present dust particles created by erosion and disintegration of animal and vegetable organic matter. It is estimated that in the city area of Paris, 50% of air pollutants emanate from home heating, 25% from industrial waste, and 25% from automobile exhaust gases. Chemically, the most analyzed pollutants are mineral and organic dust varieties, gases and vapors, particularly sulfurous anhydride, nitric oxide, fluorine compounds, ozone, and aromatic hydrocarbons. Also mentioned should be, from the point of view of noxiousness, atmospheric allergens, bacteria, viruses, and fungi, all of which can affect the human broncho-pulmonary system. Symptoms of the effect of inhaling gaseous pollutants in substantial concentration can be, in the lung area, edemata, hemorrhages, distention and rupture of alveoli; in the bronchial area, erosion of the epithelium, edema, and hemorrhage. Prolonged inhalation of air containing gaseous pollutants in lesser concentrations can induce progressive sclerosis of the alveolic walls and ensuing development of emphysema, bronchial lesions causing dilatation or spasms, and hypersecretion of mucus. The effect of the weather in the Meuse valley in 1930, and in Donora, U.S.A., in 1948 is mentioned; both are industrial areas located in valleys where, due to a temperature inversion with extended absence of wind, extremely high concentrations of pollutants, particularly sulfur dioxide, accumulated. Forty-three percent of the population of Donora was afflicted by respiratory troubles; in the Meuse valley, the number of deaths attributed to this occurrence was ten times the statistical average of the preceding years.

30841

MacEwen, J. D. and E. H. Vernot

TOXIC HAZARDS RESEARCH UNIT ANNUAL TECHNICAL REPORT: 1970. SysteMed Corp., Dayton, Ohio, AF Contract F33615-70-C-1046, Proj. 6302, Task 01, Rept. AMRL-TR-70-77, SysteMed Rept. W-70005, 87p., Aug. 1970. 51 refs. NTIS, DDC: AD 714694

The activities of the Toxic Hazards Research Unit for the period of June 1969 through May 1970 are reviewed. Modifications of the animal exposure facilities are discussed including the installation of an automatic weighing system in each Thomas Dome. Acute toxicity experiments were conducted on beta cloth glass fiber dust, chlorinetrifluoride (ClF3), oxygen difluoride, and hydrogen fluoride. There was no evidence of irritation from the beta cloth dust; histopathologic examination of the nasal passages and respiratory airways failed to show any differences between the exposed and the control animals. Lacrimation, salivation, dyspnea, and rhinorrhea were the common symptoms seen in rats and mice exposed to ClF3. Lethal concentrations produced massive alveolar and interstitial hemorrhage. Animals exposed to near lethal concentrations showed congestion, edema, hemorrhage, and emphysema. The signs of HF toxicity were similar to those seen in ClF3 exposures. Massive lung hemorrhage and edema were the characteristic findings in those animals that died during exposure to HF. Respiratory distress was seen in rodents exposed to OF2; in dogs and monkeys, gagging and emesis occurred. All animals that died had lung congestion, edema, and hemorrhage. Subacute toxicity studies were conducted on Freon 113 and methylisobutylketone. The changes observed in animals exposed to Freon 113 were all minimal; there were no signs of toxic response to methylisobutylketone. The interim results of chronic toxicity experiments on monomethylhydrazine are also discussed.

31234

Brantner, H.

THE PROBLEM OF CARIES PROPHYLAXIS IN AREAS OF HIGHER FLUORINE EMISSIONS. (Zur Problematik der Kariesprophylaxe in Gebieten mit erhoehten Fluorimmissionen). Text in German. Oeffentl. Gesundheitswesen (Stuttgart), 33(6):360-363, June, 1971. 24 refs.

The fluorine excretion with the urine of persons exposed to higher fluorine emissions was determined and compared to a control group living in a non-industrial section of the city of Graz. The fluorine excretion/1000 ml urine was used as relative value. The fluorine contents were first determined by spectrophotometry and later with an ion specific electrode. Since fluorine is not only emitted by industrial coal-fired furnaces, but also by domestic heaters, the residential areas were later included in the study. The fluorine excretion with the urine was proportional to the fluorine concentration of the atmosphere. In heavily polluted areas the excretion was significantly higher than in the control group. Therefore, it seems advisable for future caries prevention programs to consider the fluoride content of the air as well as that of the water.

31319

Schlipkoeter, H. W. and R. Dolgner

HEALTH PERILS DUE TO AIR POLLUTION. (Gesundheitsgefaehrdung durch Verunreinigung der Luft). Text in German. Atomwirtschaft, 16(6):288-293, June 1971. (Presented at the Reaktortagung Kerntechnischen Gesellschaft im Deutschen atomforum, Bonn, West Germany, March 30-April 2, 1971.)

Health risks through air pollution are discussed by means of specific examples. Emissions emanating from large industries are of limited importance only, since they effect merely the closer vicinity of the source of emission. Furthermore, the typical composition of pollutants is known for each of these industries, and their health risks can be evaluated and combatted individually. More reason for concern are emissions originating ubiquitously from all processes of incineration. Domestic heating, atuomobile engines, and a multiplicity of smaller industries produce a variety of air pollutants such as carbon monoxide, soot, polycyclic hydrocarbons, sulfur dioxide, lead compounds, and gaseous hydrochloric acid which arises in the incineration of polyvinyl compounds. Lead from automobile exhausts and fluorine compounds from aluminum works can be absorbed by food plants, and thus indirectly cause damage to the human organism. Sulfur dioxide and some hydrocarbons can attack the human respiratory tract and the lung. Dust in the air absorbs part of the ultraviolet radiation from the sun which is vital for some biological functions, for instance, the body development of children. Rickets, and affliction of the growing bone structure, and retardation in the growth of children can be ascribed to a lack of ultraviolet radiation. Carbon monoxide, when inhaled, combines with the hemoglobin of the blood to which it has a 200 time greater affinity than oxygen, and thus impedes the function of the blood in transporting oxygen.

32152

Antonelli, Giuseppe

EFFECTS OF THE PRESENCE OF FLUORINE IN AREAS IN THE VICINITY OF PLANTS WHERE IT IS PRODUCED, AND ITS TOXICITY WHEN USED FOR PROPHYLAXIS AND MEDICAL TREATMENT. (Effetti del fluoro nelle regioni prossime ad industrie di sua produzione e tossicita di esso anche negli usi profilattici a terapeutici). Text in Italian. Russ. Trimestrale di Odontoiatria, 35(2):95-123, April-June, 1954. 7 refs.

With a view to investigating the effects of fluorine exposure on the development of caries in teeth, a study was made of a hydrofluoric acid plant which uses a reaction between fluorspar and sulfuric acid. The tests conducted consisted of measuring the fluorine content and pH of watercourses in the area, toxic action on plant and animal life, effect on caries formation with plant employees and area school children, and occupational illnesses traceable to fluorine. Suggestions are given for the treatment and prophylaxis of fluorine poisoning and the proper pharmacological use of fluorine products, especially in the topical application of sodium fluoride as a means of preventing dental caries. The normal fluorine content of the teeth is 0.6%, as compared with 0.1% for the bones. The normal topical application of sodium fluoride, which consists of two cc of a two percent solution of the salt, can be considered to have negligible toxicologic effects, since even the entire maximum dosage per treatment of 40 mg NaF, assuming it were not diluted by saliva and mouth rinsings, would be insufficient to cause damage to the tissues.

32256

Wewer, Bernd

ANALYSIS OF ANIMAL EXPERIMENTS ON THE RETENTION AND ELIMINATION OF CALCIUM FLUORIDE IN THE LUNG (CONTRIBUTION TO FLUORSPAR PNEUMOCONIOSIS). (Tierexperimentelle Untersuchungen an der Lunge zur Frage der Retention und Elimination von Calciumfluorid (Beitrag zur Pneumokoniose der Flussspatarbeiter)). Text in German. Beitr. Silikose-Forsch. (Pneumokoniose), 22(4):193-235, 1970. 112 refs.

Experiments were conducted to give quantitative values of calcium fluoride lymph transport from the lung. According to its cytopathogenic effect in pattern experiments, CaF2 was expected to show an increased evacuation effect on the lymphatics. The results of fluoranalysis showed no direct influence of CaF2 on the acute course of fluorspar pneumoconiosis. During the phase of CaF2 inhalation, analysis indicated a marked decrease of retention and, histologically, an interstitial pneumonia and lymphadenitis. When another inhalation followed CaF2 inhalation, elimination of CaF2 increased and evacuation of quartz particles in the lymphatics was limited. The inflammation of the lung tissue caused by CaF2 increased the effect of quartz. Quartz increased the penetration of CaF2 into the pulmonary interstitium, where mixed dust granulomas were formed. The evacuation of quartz particles by the lymphatics was diminished by CaF2. Silicon dioxide could then develop its damaging effects since it was only eliminated from the lung by the bronchial tree to an insignificant degree; this was an especially decisive point in acute fluorspar pneumoconiosis.

32596

Dorinovskaya, A. P. and V. L. Vishnevskiy

EFFECTS OF HYDROGEN FLUORIDE ON A LUNG TISSUE CULTURE. (Deystviye ftoristogo vodoroda na kul turu legochnoy tkani). Text in Russian. Scientific Research Inst. for Occupational Health and Occupational Diseases, Sverdlovsk (USSR), Flyuoroz Ego Profil., Mater. Simp. 1966, p. 94-9.

The lung tissue culture from animals exposed to an atmosphere containing hydrogen fluoride was cultivated in a medium consisting of 0.5% lactalbumin, ox serum, and antibiotics. Five months of intoxication of the experimental animals with HF of a 3.0 mg/sq m concentration resulted in intense slow down of cell migration and it completely stopped cell growth and mitotic processes in lung tissue cultures. An 0.5 mg/sq m concentration slowed down growth and mitosis of lung cells to a much lesser degree, but even this concentration, which is the maximum permissible HF concentration in the atmosphere of industrial production plants, did not prove to be harmless for organism. Cultivation of lung tissue is considered a sensitive test suitable for investigations of the threshold concentrations and mechanisms of the effect of some harmful atmospheric substances.

32601

Petina, A. A. and L. N. El nichnykh

TOXICOLOGICAL CHARACTERISTICS OF FLUORINE DURING ITS SIMULTANEOUS ENTRANCE INTO AN ORGANISM ALONG WITH DRINKING WATER AND INHALED AIR. (Toksikologicheskaya kharakteristika ftora pri odnovremennom postuplenii ego v organizm s pit evoy vodoy i vdykhaemym vozdukhom) Text in Russian. Scientific Research Inst. for Occupational Health and Occupational Diseases, Sverdlovask (USSR), Flyuoroz Ego Profil., Mater. Simp., 1966, p. 157-163.

The experimental animals were exposed to an atmosphere containing 0.01 mg/sq m of hydrogen fluoride and to drinking water containing 0.2-1.5 mg/l of fluorine. The inhalation of fluorine in this concentration emphasized toxic effect of fluorine in drinking water Changes in motoric chronaxie and increase of fluorine content in urea were observed in studied animals. Accumulation of fluorine in the skeleton, teeth, and bone tissue were found, as well as morphological changes in the cortex of main brain and liver. On the basis of the study, the maximum permitted concentration of fluorine in drinking water in inhabited areas near industrial plants emitting fluorine

compounds was suggested not to exceed 0.5 mg/l. Since further reduction of fluorine content in drinking water is not biologically expedient, the harmful combined effect of fluorine on an organisms has to be prevented by reduction of its content in the atmosphere. Thus, the study indicates the urgency of solving the problem of purification of industrial effluents containing fluorine.

32605

Sadilova, M. S., E. G. Plotko, L. N. El nichnykh, and N. A. Polykovskaya

TOXICOLOGICAL CHARACTERISTICS OF SODIUM FLUORIDE DURING ITS INHALATION INTO AN ORGANISM. (Ktoksikologicheskoy kharakteristike ftoristogo natriya pri ingalyatsionnom postuplenii ego v organism). Text in Russian. Scientific Research Inst. for Occupational Health and Occupational Diseases, Sverdlovsk (USSR), Flyuoroz Ego Profil., Mater. Simp., 1966, p. 113-122. 4 refs.

Sodium fluoride has high solubility in biological media. During the chronic intoxication of experimental animals by inhalation of NaF, an 0.03-0.1 mg/sq m concentration had a toxic effect and cause accumulation of fluorine in bone tissue of animals. The toxic effect of a NaF concentration of 0.1 mg/sq m was manifested in retardation of the central nervous system, inhibition of blood cholinesterase and alkaline phosphatase activity, blocking of mercaptan groups in liver, and histomorphologic changes of the large brain, lungs, and liver. In 0.03 mg/sq m of NaF, increases in motoric chronaxie and decreases in blood cholinesterase and alkaline phosphatase activity were observed, but internal organs were not affected. Because of the neutral character of NaF and because of the incomplete absorption of its dust in the course of its entry into an organism through respiration organs, the degree of its toxic effect is much lower than that of analogic concentrations of hydrogen fluoride. The average daily maximum allowed concentration in the atmosphere of easily soluble fluorides should not exceed 0.01 mg/sq m.

32606

Sadilova, M. S., E. G. Plotko, L. N. El nichnykh, and N. A. Polykovskaya

TOXICOLOGICAL CHARACTERISTICS OF POORLY SOLUBLE FLUORIDES AND THE EFFECT OF THEIR INHALATION ON AN ORGANISM. (Toksikologicheskaya kharakteristika plokho rastvorimykh ftoristykh soley pri ingalatsionnom vozdeystvii na organism). Text in Russian. Scientific Research Inst. for Occupational Health and Occupational Diseases, Sverdlovsk (USSR), Flyuoroz Ego Profil., Mater. Simp., 1966, p. 123-130.

The toxic effect of the inhalation of fluorides, which are poorly soluble in biologic media, on an animal was investigated. The experimental animals were exposed to atmosphere containing finely dispersed aluminum fluoride dust in a 0.03-0.1 mg/sq m concentration for five months. Slight changes were observed in animals motoric chronaxie. Inhibition of blood cholinesterase and alkaline phosphatase and changes in the liver were observed at 0.1 mg/sq m. Fluorine content in urea was increased. The AlF3 was expelled from the organism mainly through the intestines. The degree of fluorine accumulation in bones was much lower than in the case of hydrogen fluoride or sodium fluoride inhalation. Also all changes observed during AlF3 inhalation were much weaker than those caused by HF and NaF inhalation. A comparison of the toxic effect of various fluorides shows decreasing toxicity from gaseous HF, to fluorides well soluble in biological media (NaF), to fluorides poorly soluble in biological liquids (like AlF3). The average daily maximum permissible concentration of the last should be 0.03 mg/sq m.

32607

Florentin, D.

THE DANGER OF CHEMICAL AIR POLLUTION IN CITIES. THE REMEDIES. (Le danger des pollutions chimiques de l air des villes. Les Remedes). Text in French. Ann. Hyg. Pub., Ind. Sociale, 29(11): 209-219, 1951. 13 refs.

The most prominent and dangerous air pollutants are reviewed, starting with sulfur dioxide which is emitted into the air from industrial and domestic ovens where coal, coke, or petroleum type oil is used as fuel. Some chemical and metallurgical factories also emit significant quantities of this gas. An estimate made in 1943 indicates, as a worldwide total, an emission of 37 million tons of sulfur, equivalent to 74 million tons of SO2. Through the effect of ultraviolet rays, SO2 is transformed into SO3, and the latter then to sulfuric acid which has a corrosive effect on masonry. The SO2 itself is damaging to vegetation, and in greater concentrations, such as 35 to 50 ppm, to the human respiratory organs, particularly when contained in fog formations. Another important pollutant is carbon monoxide, a product of incomplete combustion of carbon. The principal sources are exhaust gases from automotive vehicles, and the emission through chimneys from certain industrial and domestic types of incineratica. This gas is particularly dangerous for the human organism, since it combines with the hemoglobin of the blood and thus impedes the transport of oxygen by the blood stream. Carbon dioxide is far less dangerous than CO, but can have ill effects when accumulated in confined spaces due to extended exhalation without renewal of fresh air. Nitric oxides, emanating from some chemical operations, attack metals. Hydrofluoric acid is a very toxic compound. Sources for its emission can be phosphate plants, aluminum works, and iron foundries. Dust in its various forms and compositions can be damaging to the human lung, if the particle size permits penetration into the alveoli.

33276

Stokinger, H. E., N. J. Ashenburg, J. DeVoldre, J. K. Scott, and F. A. Smith

ACUTE INHALATION TOXICITY OF BERYLLIUM. II. THE ENHANCING EFFECT OF THE INHALATION OF HYDROGEN FLUORIDE VAPOR ON BERYLLIUM SULFATE POISONING IN ANIMALS. Arch. Ind. Hyg. Occupational Med., 1(4):398-410, 1950. 11 refs.

In a study conducted to determine whether hydrogen fluoride has a potentiating effect on beryllium poisoning by inhalation, 80 albino male rats were exposed for one month in groups of 10 and 20 each to beryllium sulfate mist (9 mg/cu m), to hydrogen fluoride vapor (8 mg/cu m) or to both agents in alternating daily exposures. By the 21st day of exposure, identical mortality rates of 40% had occurred in the group exposed to the two agents alternately and in the group exposed to beryllium sulfate alone. The same two groups were the only groups to show weights lower than preexposure levels. Pulmonary edema was noted only in these two groups and was as marked in rats dying from inhalation of both agents as in those dying from inhalation of beryllium alone. Alternate inhalation of hydrogen fluoride vapors and beryllium sulfate mist led to a 1.3-fold increase in the fluoride content of all hard tissue analyzed over that for animals exposed to hydrogen fluoride alone. These results are a clear demonstration that hydrogen fluoride enhances the poisonous action of beryllium.

33505

Stokinger, Herbert E., Charles J. Spiegl, Robert E. Root, Robert H. Hall, Luville T. Steadman, Catherine A. Stroud, James K. Scott, Frank A. Smith, and Dwight E. Gardner

ACUTE INHALATION TOXICITY OF BERYLLIUM. IV. BERYLLIUM FLUORIDE AT EXPOSURE CONCENTRATIONS OF ONE AND TEN MILLIGRAMS PER CUBIC METER. Arch. Ind. Hyg. Occupational Med., 8(6):493-506, Dec. 1953. 23 refs.

Pulmonary lesions were produced in animals exposed to beryllium fluoride mist at concentrations of 10 and 1 mg/cu m. These closely resemble the lung changes resulting from inhalation of beryllium sulfate. Beryllium fluoride is acutely more toxic than beryllium sulfate. Exposure to 1 mg BeF2/cu m resulted in lung damage in cats, rabbits, and rats comparable in extent and degree to that produced by 10 mg of beryllium sulfate mist/cu m. Macrocytic anemia occurred in dogs and rabbits exposed to 1 mg BeF2/cu m. The anemia was more severe than that observed after inhalation of beryllium oxide dust or beryllium sulfate mist. Urinary uric acid excretion can possibly serve as an index of the degree of exposure to beryllium. Beryllium tended to accumulate in the lungs, pulmonary lymph nodes, liver, skeleton, and bone marrow of dogs. The deposition rate in the lungs and lymph nodes increased with the duration of exposure. A greater proportion was distributed to the skeleton, liver, spleen, and kidney after inhalation of BeF2 than occurred with beryllium oxide dust or beryllium sulfate mist in earlier studies. (Author summary modified)

33509

Lindberg, Z. Ya.

EFFECT OF INSTANT MAXIMUM PERMISSIBLE CONCENTRATIONS OF SULFUR DIOXIDE AND HYDROGEN FLUORIDE WHEN SIMULTANEOUSLY PRESENT IN THE ATMOSPHERE. (Razovyye predel no dopustimyye kontsentratsii SO2 i HF pri ikh sovmestnom prisutstvii v atmosfernom vozdukhe). Text in Russian. Riga Medical Inst. (USSR) Mater. Dokl. Nauch. Sess. Rizh. Med. Inst., 15th, 1967, p. 42-43.

The biological effect of sulfur dioxide and hydrogen fluoride when both are present in the atmosphere at their maximum permissible concentration was studied. First the minimum permissible concentration of impurity sensed by olfactory organs of 17 studied people was determined. In case of most sensitive persons it was 1.6 and .04 mg/cu m SO2 and HF, respectively. The indices of concentration of each mixture of HF and SO2 were expressed as sum of fractions of their maximum permissible concentrations when only one is present. The lowest mixture concentration sensed by olfactory organs was a mixture characterizing complete summation of the effect of both components, its index being equal to one. Some atmospheric pollutants cause a change in light sensitivity of an eye, even if in concentration is lower than sensed by olfactory organs. Therefore, the reflex effect of above substances was studied by the adaptometric method. The changes in light senstivity of the eye were observed for mixtures with a mixture concentration index equal to one. The data obtained indicate the summation of effect of SO2 and HF when simultaneously present in the atmosphere.

33510

Lindberg, Z. Ya.

EFFECT OF EFFLUENT FROM A SUPERPHOSPHATE PLANT ON WHOLE-BLOOD CHOLINESTERASE ACTIVITY IN ANIMALS EXPOSED UNDER NATURAL CONDITIONS. (Vliyaniye vybrosov superfosfatnogo zavoda na aktivnost tsel noy krovi u eksperimental nykh zhivotnykh, eksponirovannykh v natural nykh usloviyakh). Text in Russian. Aktual. Voprosy Gig. Truda Prof. Patol., Mater. Konf., 1st, 1967, p. 236-238.

Experimental animals rabbits and white rats, were kept for five months 1000 from a superphosphate plant at point of maximum atmospheric pollution with the wind blowing in that direction from the plant. The effect of emissions inhaled by the animals was studied; animals were fed by fodder grown in an unpolluted area or by fodder grown in the vicinity of the plant. During the observation, the average concentrations of sulfur dioxide, fluorine, sulfuric acid mist, and nitrogen oxides in the atmosphere were 2.8-6.4 times higher than the maximum permissible concentration. The determination of the activity of whole-blood cholinesterase was accepted as a sensitive test in study of effect of toxic substances on animals. The average daily concentrations of the above substances in the atmosphere in the vicinity of the superphosphate plant unfavorably effect organisms specifically, they increase the activity of cholinesterase.

33511

Lindberg, Z. Ya.

EFFECT OF HYDROGEN FLUORIDE AND SULFUR DIOXIDE ON AN ORGANISM WHEN BOTH ARE PRESENT SIMULTANEOUSLY. (Deystviye ftoristogo vodoroda i sernistogo gaza na organizm pri ikh sovmestnom prisutstvii). Text in Russian. Scientific Research Inst. for Occupational Health and Occupational Diseases, Sverdlovsk USSR, Flyuoroz Ego Profil., Mater. Symp., 1966, p. 131-138.

Experimental animals located 1000 m from a superphosphate plant were exposed to emissions for five months. The emissions entered the animals both orally and by inhalation. Maximum average fluorine concentration was .15 mg/cu m and sulfur dioxide concentration was .84 mg/cu m. The morphological composition of the blood changed with a decrease in erythrocytes, hemoglobin, sugar, calcium, phosphorous, and cholinesterase activity. Pathological changes in the lungs were also observed. Thus, a safety zone of 1000 m around the production plant is not enough. The combined effects of hydrogen fluoride and SO2 on humans produced olfactory sensations and changes in the light sensitivity of the eyes. The maximum permissible concentration of the mixture expressed as a sum of fractions of maximum permissible concentrations of HF and SO2 must not be more than one. White rats were subjected to three months chronic inhalation of HF and SO2. Changes in motoric chronaxy, cholinesterase activity, and hemoglobin content were observed. Coproporphyrin in the area of animals increased. Also, histologic changes in the lungs occurred. The simultaneous presence of HF and S02 in their maximum permissible individual concentrations is not permissible. The permissible level should be determined from the sum of their relative concentrations.

33561

Sadilova, M. S., E. G. Plotko, L. N. El nichnykh, and K. P. Selyankina

TOXICOLOGICAL CHARACTERISTICS OF HYDROGEN FLUORIDE DURING CONTINUOUS INHALATION BY ANIMALS. (Toksikologicheskaya kharakteristika ftoristogo vodoroda pri kruglosutochnoy ingalatsioynoy zatravke zhivotnykh). Text in Russian. Scientific Research Inst. for Occupational Health and Occupational Diseases, Sverdlovsk (USSR), Flyuoroz Ego Profil., Mater. Simp., 1966, p. 105-12.

Hydrogen fluoride a 0.03-0.1 mg/sq m concentration had a toxic effect during a continuous five-month intoxication of ex-

perimental animals. It caused changes in functional condition of central nervous system of the animals and changes in their motoric chronaxy. Along with this, the accumulation of fluorine in teeth and bone tissue and development of specific diseases of teeth and bone tissue were observed. Concentration of 0.01 mg/sq m caused only changes in phosphorus-calcium exchange, observed by isotopic indication. This concentration is therefore considered threshold. The average daily maximum permissible HF concentration in the atmosphere of inhabited areas is suggested to be equal to 0.005 mg/sq m.

33766

Leloczky, Maria

STUDIES ON THE HEALTH-DAMAGING EFFECT OF THE FLUORINE-POLLUTION OF THE AIR AROUND AN ALUMINUM FACTORY. (A levego fluorszennyezodesenek egeszseguyi hatasa az Inotai Aluminumkoho kornyeken vegzett vizsgalatok alapjain). Text in Hungarian. Egeszsegtudomany, vol. 15:74-80, July 1971. 21 refs.

Children in the housing estate Varpalota-Inota were examined for the effects of fluorine pollution from a nearby aluminum foundry. The presence of fluorine in the urine of the children was demonstrated, in some cases at a level usually found in the urine of the foundry workers. In a fluorine-free control area, no fluorine could be demonstrated in urine from children. The hemoglobin level of the children at risk was low. A causal relationship between these findings and the fluorine pollution of air cannot be established because fluorine is only one of the air pollutions around Varpalota-Inota. Further investigations are in progress. (Author abstract modified)

33872

Hall, Robert H., L. T. Steadman, Catherine A. Stroud, James K. Scott, F. A. Smith, and Herbert E. Stokinger

ACUTE TOXICITY OF INHALED BERYLLIUM. IV. STUDIES OF BERYLLIUM FLUORIDE AT CONCENTRATIONS OF 10 AND 1 MG/CU M. Rochester Univ., N. Y., Atomic Energy Project, Atomic Energy Commission Contract W-7401-eng-49, UR-177, 39p., July 17, 1951. 16 refs.

Pulmonary lesions were produced in animals exposed daily to beryllium fluoride mist at concentrations of 10 and 1 mg/cu m. These closely resembled the lung changes resulting from inhalation of beryllium sulfate. BeF2 was more toxic than beryllium sulfate. Exposure to 1 mg/cu m BeF2 resulted in lung damage in cats, dogs, rabbits, and rats roughly comparable in extent and degree to that produced by 10 mg/cu m of beryllium sulfate. Hematologic changes, suggestive of the development of macrocytic anemia, occurred in dogs and rabbits exposed to 1 mg/cu m BeF2. The proportion of mature polymorphonuclear leukocytes decreased in the circulating blood. Beryllium tended to accumulate in the lungs, pulmonary lymph nodes, liver, skeleton, and bone marrow of dogs. The rate of deposition in the lungs and lymph nodes increased with the duration of exposure. Deposition in the skeleton was greater in all four species studied than in any other tissue except the lungs and lymph nodes. The evidence suggests that there are specific differences in the rate and manner in which inhaled BeF2 is transported from the lungs to other tissues, or excreted in the urine or feces, in the four species studied. A considerably greater proportion was distributed to other tissues after inhalation of BeF2 than was found in studies of insoluble beryllium oxide and soluble beryllium sulfate mist, possibly because BeF2 is transported in the blood in the form of a soluble, diffusible complex containing one atom of fluorine/mol of beryllium. (Author summary modified)

34398

Truhaut, Rene

THE PROBLEM OF PERMISSIBLE LIMITS OF POTENTIALLY TOXIC SUBSTANCES IN THE WORKING AND GENERAL ENVIRONMENT OF MODERN MAN. (Le probleme des limites admissibles pour les polluants de l air). Text in French. Prod. Probl. Pharm., 26(8):530-548, Aug./Sept. 1971. 47 refs.

The effects of exposure to various pollutants on human health are examined to determine maximum allowable concentrations. Immediate and insidious toxic effects and long-range effects, including potential carcinogenicity, are reviewed and correlated with respective dosages to establish toxic tolerances and thresholds. The methodology for evaluating risks and the selection of adequate criteria are discussed. The concept of air quality standards is defined, and maximum allowable concentrations for chlorine, hydrogen chloride, ozone, sulfur dioxide, hydrogen sulfide, ammonia, hydrogen arsenide, n-butyl alcohol, butyl amine, sulfuric acid, chromic acid, zinc oxides, vanadium dusts and smokes, fluorides, beryllium, cadmium oxides, various aromatic hydrocarbons, and other dusts, gases, and vapors are listed. The complexity of urban air pollution, frequent chemical changes of the atmosphere due to certain environmental factors, and socio- economic considerations of applying air standards to general community air pollution are discussed.

34861

Truhaut, Rene

THE FLUORESES. THEIR IMPORTANCE IN INDUSTRIAL AND ALIMENTARY HYGIENE. ANALYTICAL METHODS APPLICABLE TO THEIR STUDY. (Les fluoreses. Leur importance en hygiene industrielle et en hygiene alimentaire. Les methodes analytiques applicables a leur etude). Preprint. Paris Univ. (France), Faculty of Pharmacy, Translated from French, 77p.

A toxicological study of fluorine derivatives is presented. The principal compounds which pose an effect to health are indicated, as well as their distribution in nature and their principal industrial uses. Symptoms of exposure to the fluorine derivations are described, including acute and chronic intoxication. Analytical reactions of the fluorine ion are presented. Elimination of fluorosis is discussed.

35569

GUIDES FOR SHORT-TERM EXPOSURES OF THE PUBLIC TO AIR POLLUTANTS. III. GUIDE FOR GASEOUS HYDROGEN FLUORIDE. National Academy of Sciences, National Research Council, Washington, D. C., Committee on Toxicology, Air Pollution Control Office Contract CPA 70-57, 15p., Aug. 1971. 16 refs. NTIS: PB 203465

The primary effect of acute exposure to gaseous hydrogen fluoride in concentrations above a few mg/cu m is irritation of the skin, eyes, and respiratory passages. In addition, localized tissue damage may occur as a result of the corrosive nature of this compound at concentrations above the recommended limits. Exposure to concentrations higher than 10 mg/cu m may lead to pulmonary edema and respiratory distress. This may be accompanied by gastroenteritis, with nausea, vomiting, abdominal burning, diarrhea, and collapse. Exposure to lethal concentrations produces muscular weakness and tremors, clonic convulsions, a drop in blood pressure, and moderate cyanosis; and death may result from sudden respiratory or cardiac arrest. Toxicity studies with animals are cited, as well as reported case of HF poisoning from accidental exposures in

industrial environments. Plants are more susceptible to damage from gaseous HF than are animals, although among plant species there is a wide variation in tolerance. Cattle, sheep, and goats that feed on fluoride-contaminated forage may sicken and die from chronic fluoride poisoning, fluorosis. Atmospheric concentrations of HF are indicated, as well as the basis for setting limits for short-term and emergency exposure of the public to HF. Sources and physical-chemical properties of HF are cited.

35670

Sadilova, M. S., T. S. Egorova, and V. L. Vishnevskiy

REFLEX REACTIONS OF AN ORGANISM UNDER THE EFFECT OF HF, NAF AND ALF3. (Nekotoryye reflektornyye reaktsii organizma pri deystvii HF, NaF i AlF3). Text in Russian. Flyuoroz Ego Protil., Mater. Simp., 1966, p. 100-104. 2 refs.

The effect of hydrogen fluoride and its salts in the atmosphere on the sensitivity of the human eye was studied using an adaptometer. Participants in the experiment were placed in a completely darkened room. After 15 minutes of adaptation to darkness, air containing various concentrations of HF or its salts was introduced into the room. A diaphragm over the light spot kept open until noticed by the subject. Results are expressed in optical density. An increased sensitivity of eye to light was observed in the presence of studied materials in following concentrations: .03 mg/cu m HF, .05 mg/cu m NaF, and .3 mg/cu m AlF3. Thus, the maximum permissible concentrations recommended are, for HF, .02 mg/cu m; for NaF, .03 mg/cu m, and for AlF3, .2 mg/cu m.

36411

Vishnevskiy, V. L.

EFFECT OF HYDROGEN FLUORIDE ON INTEGRAL INDICES OF THE CONDITION OF ANIMALS. (Vliyaniye ftoristogo vodoroda na integral nyye pokazateli sostoyaniya organizma zhivotnykh). Text in Russian. Scientific Research Inst. for Occupational Health and Occupational Diseases, Sverdlovsk (USSR), Flyuoroz Ego Profil., Mater. Simp., 1966, p. 81-89.

The effect of hydrogen fluoride inhalation on the organism of white rats was studied during their exposure to HF atmosphere in a .1-3.0 mg/cu m concentration for five months for six hours daily. The composition of the peripheral blood of the animals was slightly effected by HF. In all studied cases, the tendency towards decrease in hemoglobin content was observed. The condition of central nervous system under HF inhalation was studied by method of conditioned reflexes and by chronaxymetry. It revealed the prevalence of inhibition of reflexes in the cortex of the large brain and disruption of motoric chronaxy.

36723

Masironi, Roberto

TRACE ELEMENTS AND CARDIOVASCULAR DISEASES. Bull. World Health Organ. (Geneva), vol. 40:305-312, 1969. 82 refs. (Presented at the IAEA Panel Meeting on Activation Analysis in the Study of Mineral Element Metabolism in Man, Teheran, Iran, June 1968.)

The relationship between trace elements and cardiovascular diseases was reviewed. The trace element that is studied most extensively in relation to cardiovascular diseases is cadmium, which appears to play a number of detrimental roles, particularly in relation to arterial hypertension. Further investigations are needed to ascertain whether this element really plays a role and to establish what mechanism is involved. Zinc concentrations in the air are reported to correlate strongly with death rates from hypertension and atherosclerosis, as cadmium does. Manganese also seems to play a role in atherosclerosis: it prevents the development of experimental atherosclerosis in rabbits and has a beneficial effect on lipid metabolism in atherosclerotic patients. Another trace element that appears to exert a beneficial effect on atherosclerosis is chromium. Experiments in rats show that chromium deficiency is associated with a high prevalence of aortic plaques whereas a lifetime administration of this metal in trace amounts prevents the formation of atheromatous lesions, decreases the blood cholesterol level, and prolongs the life-span of the animals. The relationship of cobalt is not clear. Arsenic may cause myocardial necrosis both in animals and man. Vanadium reduces the cholesterol level in plasma and in the aorta of rabbits and in healthy humans. The rapid increase of nickel in the blood may perhaps be used as a diagnostic indicator of recent myocardial infarction. Silicon plays a functional role since it protects the elastic state of the artery walls and maintains the intima impermeable to lipid infiltration. Selenium, copper, and fluorine were also discussed.

36751

Salazar, Antonio Ruiz and Alejandro Castanedo

PATHOLOGY IN PETROLEUM INDUSTRY. (Patologia de la Industria del Petroleo). Text in Spanish. Med. Deporte Trab., 18(128):560-581, 624-641, 647, 1953. 29 refs. (Presented at the Medicina del Trabajo, Congreso Americano, 11th, San Pablo, Brazil.)

Massive hydrogen sulfide poisoning was manifested in a workers camp situated in the vicinity of a natural gas refining plant in Poza Rica, Mexico. The raw natural gas contains 4.39% H2S. Due to unusual meteorological conditions (temperature inversion), the H2S from the refinery exhaust fumes did not dissipate in the upper atmospheric layers; accordingly, it contaminated the area and resulted in 330 cases of H2S poisoning. Twenty-five patients died almost immediately and 45 others required hospitalization for 2-15 days; the others recovered following emergency treatment. The patients presented respiratory, circulatory, digestive, urinary, and central nervous system disorders. Histopathological examination (at autopsy) revealed alterations in the kidneys, liver, and lungs. In the alkylation department of a petroleum refinery there were 16 accidents due to contact with hydrofluoric acid (HF), nine instances of poisoning due to inhalation of HF, and one case of allergy to HF. Of 574 cases of lung tuberculosis in the Mexican petroleum industry, 117 were refinery workers, 121 were office workers, while the others were auxiliary personnel and oil field workers; however, the incidence of tuberculosis among petroleum industry workers does not seem to be higher than in the general Mexican population. Occupational pathology in the petroleum industry is reviewed extensively.

36947

National Academy of Sciences - National Research Council, Washington, D. C., Committee on Biologic Effects of Atmospheric Pollutants

FLUORIDES. Washington, D. C., National Academy of Sciences, 1971. 295p. 751 refs.

Severe effects of airborne fluoride on man, such as crippling fluorosis, have so far been observed only from long-term occupational exposures. Osteosclerosis, as evidenced by increased density to x-rays, may be associated with a concentration of about 6000 ppm of fluoride in bone. Analysis of urinary fluoride is recommended as a means of monitoring populations

for possible excessive exposures to fluoride. The current threshold limit valve for fluorine gas is 0.1 ppm v/v; for hydrogen fluoride, 3.0 ppm; and for particulate fluoride, 2.5 mg/cu m. Environmental sources and forms of fluoride are considered, as well as the fate and transformations of fluoride, its environmental analysis, and general aspects of its effects on living systems. In addition to human health effects, the effects of fluoride on vegetation and animals are considered. Recommendations for future research are made.

37139

Sadilowa, M. S. and L. N. Jelnitschnych

EXPERIMENTAL TOXICOLOGIC VALUES FOR THE HYGIENIC ASSESSMENT OF LOW CONCENTRATIONS OF INORGANIC FLUORINE COMPOUNDS IN THE AIR. (Toxikologische Experimentalwerte zur hygienischen Einschaetzung geringer Konzentration anorganischer Fluorverbindungen in der Luft). Text in German. Z. Ges. Hyg. Ihre Grenzgebiete (Berlin), 13(10):741-745, 1967. 3 refs.

The toxicity of fluorine compounds was investigated to determine maximum allowable concentrations. The severity of the toxic effects of different fluorine compounds depends on the concentration and solubility in the biological media. For biological aggressiveness, fluorine gases rank first, followed closely by fluorides, and then by hardly soluble fluorine salts. Unique and daily average maximum allowable concentrations were, therefore, established, respectively, at 0.02 and 0.005 mg/cu m for gaseous fluorine compounds, 0.03 and 0.01 mg/cu m for fluorides, and 0.2 and 0.03 mg/cu m for the hardly soluble salts.

37240

Gerdes, R. A.

THE INFLUENCE OF ATMOSPHERIC HYDROGEN FLUORIDE ON THE FREQUENCY OF SEX-LINKED RECESSIVE LETHALS AND STERILITY IN DROSOPHILA MELANOGASTER. Fluoride, 4(1):25-29, Jan. 1971. 8 refs. (Presented at the Conference of the International Society of Fluoride Research, Annual, 3rd, Vienna, Austria, March 22-25, 1970.)

The influence of hydrogen fluoride as an atmospheric contaminant was investigated in the Oregon-r strain of Drosophila malanogaster. Two principle parameters of mutagenicity were used: sex-linked recessive lethals and sterility. The flies were exposed in fumigation chambers to 1.3, 2.9, or 4.3 ppm HF for three or six weeks. Sex-linked recessive mutation frequency increased at each level of sublethal concentration. The frequencies of sterility in both males and females increased with increased treatment level and treatment period. Genetic differences were observed in the response of the progeny of treated flies. The sex-linked recessive lethals indicated an effect on a specific chromosome; the increased sterility levels resulted from a broad effect on the genome as a whole. (Author abstract modified)

37282

Steinegger, S.

HISTOLOGY OF CHIZZOLA MUCULAE. Fluoride, 5(1):14-17, Jan. 1972. 4 refs.

In recent years, skin lesions resembling traumatic suffusions have occurred in epidemic proportion in two Italian cities located near aluminum and other fluoride-emitting factories: Chizzola and Bolzano. Morphologically, the lesions are round or oval in shape. They have reddish-brown color when they originate but change to a bluish-brown prior to their disappearance. As determined by skin biopsies on three children with characteristic maculae, pericapillar lymphocytic infiltration and proliferation of endothelial cells of capillaries are the principle pathological features of the lesions. These features suggest a toxic inflammatory process.

37569

Balazova, G.

LONG TERM EFFECT OF FLUORIDE EMISSION UPON CHILDREN. Fluoride, 4(2):85-88, April 1971. 4 refs. (Presented at the International Society of Fluoride Research Conference, Annual, 3rd, Vienna, Austria, March 22-25, 1970.)

Five years after an aluminum smelter began operation, an 8-year study was initiated of the health status of 6- to 14-year-old children living in close proximity to the smelter. In the study area, the daily fluoride intake averaged 1.4 mg from food, 0.4-0.7 mg from air, and 0.1-31 mg/l from water. In a control area, the daily F(-) intake from food was 0.8 mg, and that from air was negligible. No evidence of skeletal fluorosis was found in the exposed children. Nevertheless, the average hemoglobin decreased and the F(-) content of teeth, nails, hair, and urine increased in the children. In teeth, fluoride levels averaged 45.02 mg/100 g (450 ppm) of the original weight compared to 15.71 mg in controls. Nail fluoride levels were 20.9 mg/100 g (209 ppm) for the exposed children versus 14.3 mg/100 g (143 ppm) for the controls. The F(-) content of hair in the affected area averaged 1.6 mg/100 g (16 ppm) compared to 0.75 mg/100 g (7.5 ppm) in the control area. Urinary fluoride values were 0.8 ppm and 0.4 ppm, respectively for the exposed children and the controls. In the smelter area, the urinary excretion of F(-) was lower in the 12-14 age group than in children aged 6-11.

37684

Balazova, G.

THE EFFECTS OF A PROLONGED INDUSTRIAL ATMOSPHERIC POLLUTION FROM FLUORINE ON CHILDREN S ORGANISM. (Der langfristige Einfluss von Fluoremissionen auf den Kinderorganismus). Text in German. Med. Lavoro (Milan), 62(4):202-207, April, 1971. 11 refs.

The effect of fluorinye emissions from an aluminum factory on the health of children living near the plant was investigated after 8 yrs of plant operation. The absorption of fluorine through food and in the air was examined. The theoretical daily intake of fluorine should be 1.4 mg food and 0.4-0.7 mg from air; in the control zone, the absorption in food was 0.9 mg/day and was practically insignificant in air. The fluorine content of drinkable water in both the control and exposed areas was 0.1-0.3 mg/l. Although no signs of fluorosis detected, the fluorine content of teeth, nails, hair and urine of the children exposed to plant emissions was higher than that of controls. The average values for the exposed and control groups, respectively, were 45.02 and 15.7 mg/100 g in the teeth; 20.9 and 14.3 mg/100 g in the nails; 1.6 and 0.7 mg/100 g in the hair; and 0.8 and 0.4 mg/l in the urine.

37791

Villiers, A. J. de, J. P. Windish, F. de N. Brent, B. Hollywood, C. Walsh, J. W. Fisher, and W. D. Parsons

MORTALITY EXPERIENCE OF THE COMMUNTY AND OF THE FLUORSPAR MINING EMPLOYEES AT ST. LAWRENCE, NEWFOUNDLAND. Occupational Health Rev. (Ottawa), 22(1/2):1-15, 1971. 6 refs.

The unusual incidence of lung cancer among the miners of St. Lawrence, Newfoundland spurred epidemiological investiga-

tions which revealed a radiation hazard in the fluorspar mines located in the area. Environmental surveys for determinations of dust and radiation concentrations were conducted as well as epidemiological studies of community and occupational mortality. Although free silica content was high in certain instances, the general degree of dustiness at the time of the survey was not alarming. Average dust concentrations were above the threshold limit value at seve underground and two surface locations. Average fluoride concentrations were well below the limit at each of the localities sampled. High relative concentrations of radon and radon daughters were determined in the working places. The environmental survey data and results of epidemiological studies are tabulated. Exposure to radon was pinpointed as the most important site-potentiating and cancer-inducing factor.

37795

FLUORIDE INTOXICATION IN HUMANS. Fluoride Quart. Repts., 4(3):102-108, July 1971. 40 refs.

Fluoride enters the human system through ingestion with food and water, less through inhalation, and to an even more limited extent through the skin. In a nonfluoridated area, the estimated F(-) intake through food is 0.03-0.5 mg/day. In a fluoridated community, the daily intake by healthly indoor workers is 3/5 mg. Acute poisoning occurs following excessive inhalation of ingestion of F(-) compounds. The acute phase is of significance in evaluating health effects due to air and water pollution, since the acute abdominal pains associated with it are not uncommon during the chronic stage of the disease, probably due to temporary consumption of extraordinarily contaminated food or water. Chronic intoxication can be classified according to its major causes as follows: hydrofluorosis due to drinking water; industrial fluorosis; neighborhood fluorosis, which occurs in populations near F(-)-emitting industries; and alimentary fluorosis due to fluoride-containing food. The clinical picture of F(-) poisoning varies considerably from person to person because of wide differences in F(-) uptake, storage, and excretion. The dental and skeletal changes on which physicans usually depend for the diagnosis of chronic intoxication are not obligatory features of the disease.

38106

Takizawa, Yukio, Koji Sato, Tatsuo Oshina, and Ryuichi Sugai

EFFECT OF AIR POLLUTION CAUSED BY FLUORIDES ON HUMAN BODIES. (Fukkabutsu ni yoru talkiosen no jintai ni oyobosu eikyo ni tsuite). Text in Japanese. Nippon Koshu Eisei Zasshi (Japan. J. Public Health), 18(10):428, 1971.

At the Naoetsu coastal factory area, an aluminum refinery with an annual product of about 150,000 tons has been in operation since May, 1963. The results of mass medical examinations conducted for the inhabitants of over 40 yrs old who had been living in the area within 1 km from this refinery for more than 5 yrs (Naoetsu area-708, Kubiki area-444, and control area-93, amounting to 1245 in total) are briefly reported here. For the investigation, examinations of subjective symptoms, general medical and dental examinations, respiratory function tests, and urine tests were conducted in Nov. 1970, and in March 1971, tests for basal metabolic rate, bone examinations by X-ray, electrocardiography and functional tests of blood and enzymes were carried out. The amount of urinal F was 0.574 ppm on the average in 62 people of controlled group, and with a screening standard of 1.2 ppm, the number of high excreters became 107; and it was significantly high in contaminated area. Proliferation or calcification of bone was also evident, but there was no areal difference, and there was no osteosclerosis nor spotted teeth. Findings in chest X-ray tests revealed a high rate of pulmonary fibrosis.

38616

Barnea, Matei and Pascu Ursu

NOXIOUS EFFECTS OF AIR POLLUTION. (Efectele Nocive ale impurificarii aerului). Text in Romanian. In: Protectia atmosferei impotriva impurificarii cu pulberi si gaze. Bucharest, Romania, Editura Technica, 1969, Chapt. 7-9, p. 130-183.

The mechanism of interaction between air pollutants and the respiratory tract is analyzed. Aerosols are categorized into toxic and nontoxic species and the indirect damaging of the latter as carriers for toxic substances is pointed out. The action of lead, fluorine, arsenic, beryllium, Manganese, and carcinogenic compounds is reviewed among the toxic aerosols. Included are discussions on the action of carbon monoxide, sulfur dioxide, nitrogen oxides, chlorine, hydrogen sulfide, and oxidant gases on the animal and plant organism. Reference is made to air pollution dwelling in metropolitan areas such as London, Los Angeles, or New York. Data illustrating morbidity and mortality due to chronic exposure to polluted environments are included. Discussions on economic damage from air pollution due to construction and other material deterioration are presented. The effect of air pollution on meteorology and solar radiation is also discussed.

38721

Corn, Morton

DOSE TO THE RESPIRATORY TRACT FROM PERSONAL, OCCUPATIONAL AND COMMUNITY AIR POLLUTANTS. Environ. Letters, 1(1):29-39, Jan. 1971. 8 refs. (Presented at the Pennsylvania Tuberculosis and Health Society, Annual Meeting, 78th, Pittsburgh, Pa., April 29, 1970.)

The doses (concentration-time) to the respiratory tract by urban, occupational and personal pollutants were calculated by assuming the pollutant concentrations in air equivalent to air quality standards, threshold limit values, and reported cigarette smoke concentrations, respectively. Urban pollution includes carbon monoxide, nitrogen oxides, lead, hydrocarbons, smoke, ash, sulfur dioxide, sulfuric acid, fluorine, beryllium, cadmium oxides, zinc oxides, pollens, allergens, and particulate matter from automotive, domestic, industrial, and natural sources; occupational pollution consists of dusts, fumes, gases, organic dusts, and radioactive particles within industries. The most severe challenge by a large margin was that posed to the pack-a-day cigarette smoker. Assumptions and results of calculations are presented. (Author abstract modified)

38942

Tsunoda, Fumio, Hiroko Kunida, and Kazuo Sasaki

A STUDY ON THE EFFECTS OF AIR POLLUTION DUE TO FLUORIDES ON HUMANS IN THE VICINITY OF MANUFACTURING FACTORY (1). (Arumi kojo shuhen ni okeru fukkabutsu ni yoru talkiosen no seitai ni oyobosu eikyo ni kansuru chosa kenkyu (1)). Text in Japanese. Kankyo Hoken Reporto (Environ. Health Rept.), no 8:41-51 Jan. 1972.

Effects of fluorides on human and the results of epidemiological studies carried out in Japan, were described. Schoolchildren living near an aluminum factory in Japan were tested as to subjective symptoms, mottled teeth, lung ventilation, x-ray examination of the bones, and fluorine concentration in urine. The incidence of malaise was remarkably higher in schoolchildren from a polluted area. Many schoolchildren of the polluted

area showed mottled teeth and osteosclerosis of the knee joint. The amount of fluorine taken into body/day was investigated in fifty 30-60-year-old residents living around the same factory. A farming area within 500 m under the lee of the main wind was determined as a polluted area, and the other farming area over 6 km from the factory was determined as the control. Investigated items were staple foods intake and fluorine intake from them, fluorine intake from subsidiary foods, fluorine intake from drinking water, and excretion of fluorine in urine. Intake of fluorine from staple foods was significantly higher in residents of the polluted area, and its mean value was 2.89 ppm, 40% higher than that of the control. Fluorine taken from the air and the water by residents of the polluted area was suspected to be 0.1 mg higher/day than that by residents of the control area. Fluorine in urine was higher in residents of the polluted area, but the relationship between the intake and excretion of fluorine was not clarified.

39219

Roholm, Kaj

THE FOG DISASTER IN THE MEUSE VALLEY, 1930: A FLUORINE INTOXICATION. J. Ind. Hyg. Toxicol., 19(3):126-137, March 1937. 47 refs. (Presenteć at the Danish Society for Internal Medicine, Oct. 30, 1936.)

The fog disaster which occurred in the Meuse Valley near Liege, Belgium, early in December 1930, involved several thousand cases of sickness and 60 deaths. An analysis of the details of the disaster gives circumstantial evidence that the malady was acute fluorine intoxication. Of the 27 factories in the region, fifteen are industrial branches which either use raw products containing fluorine (superphosphate works, zinc works) or add fluorine compounds to the raw materials (steel works, iron foundries, glass works), involving the possibility of passing gaseous fluorine compounds into the chimney smoke. Special climatic and topographic conditions played an important role in the development of the disaster. A survey of acute and chronic fluorine intoxication is included. (Author summary modified)

39494

Martin, A. Edmund

POLLUTION. ITS EFFECT ON HEALTH. Ind. Process Heat., 1970:17-18, Nov. 1970.

The impact of environmental pollution on human health is reviewed. The predominant hazard to health is tobacco smoke. Second to this come pollution of the atmosphere by smoke, soot, grit, ash, hydrocarbons, carbon oxides, sulfur oxides, nitrogen oxides, fluorides, ammonium salts, and other trace elements and the potential hazard of contamination of drinking water and foods. Studies and health statistics have established a relationship between air pollution, smoking, and various respiratory diseases, including lung cancer and chronic bronchitis. The need for research in these fields and for pollution control techniques is apparent.

39497

Cristiani, H.

IS THERE FLUOROSIS OR FLUORINE CACHEXIA IN HUMANS? (Existe-t-il chez l homme une fluorose ou cachexie fluorique?). Text in French. Presse Med. (Paris), no. 53:833-834, July 13, 1926.

Problems of possible fluorosis and fluorine cachexia in humans are discussed. The amounts of fluorine entering the human organism under normal conditions are not capable of producing intoxication. Acute poisonings are of an accidental character. Fluorine- containing products are, however, massively used as pesticides and preservative agents in different foodstuffs. Such fluorine may cause poisonings. The amount of fluorine entering the human organism (0.13-1.3 mg/kg) is too low to cause acute poisoning, but it can produce poisoning after a long period of time, the length of which has not yet been clarified. Very small doses are capable of causing lethal cachexia, which makes investigations, into the possible dangers necessary. According to an investigation, doses of about 2 cg/kg lead to lethal cachexia in animals. Due to the intense milk consumption, infants are most affected by fluorine hazards. Measures should be taken to prevent the abuse of fluorine compounds as preservatives.

39799

Cristiani, H. and R. Gautier

EXPERIMENTAL FLUORINE CACHEXIA: CHRONIC ACTION OF SODIUM FLUOROSILICATE IN SMALL DOSES. (La cachexie fluorique experimentale: effets chroniques de petites doses de fluosilicate de soude). Text in French. Compt. Rend. Soc. Biol. (Paris), 1925:946-948, 1925.

The chronic action of small doses of sodium fluorosilicate was studied on two groups of guinea pigs. The feed was powdered with two different doses of fine sodium fluorosilicate, in both cases. In the first group of 13 animals, treated with doses of 2 g, deaths occured, on an average, 35 days after the experiment started, with maximum and minimum of 64 and 9 days, respectively. The same symptoms were observed in all animals (loss of weight, cachexia, bulbous lesions). Special symptoms occurred a few days before death in some cases (stiffening of the spinal column, respiration troubles, tremors, and convulsions). The second group of 10 animals was exposed to 1/10 of the above dose. Death occurred, on an average, after 149 days, the maximum and minimum being 553 and 41 days. The cachexia was preceded by loss of weight. Similar symptoms and results were obtained with fluorine contaminated feed collected near aluminum plants.

39810

Cristiani, H. and R. Gautier

THE ACTION OF ALKALINE FLUORIDES ON ANIMALS. (Action des fluorides alcalins sur les animaux). Text in French. Compt. Rend. Soc. Biol. (Paris), 1925:1276-1277, 1925. 1 ref.

Tests were carried out with sodium and ammonium fluoride powder introduced in the feed of guinea pigs. Sodium fluoride was applied in doses of 2 g/cage of two animals. Deaths occurred, on an average, 54 days after the start of the treatment, with maximum and minimum of 86 and 22 days, respectively. The average weight of the animals increased at the beginning and dropped sharply in the cachexia period. Similar results were obtained with another group of 10 animals, treated in the same manner with ammonium fluoride. Deaths occurred, on an average, on the 58th day of the treatment, the maximum and minimum being 74 and 41 days, respectively. The symptoms observed were the same as in the case of sodium fluoride. Treatments with sodium fluorosilicate led to similar results.

39813

Cristiani, H. and P. Chausse.

MINIMUM DAILY AMOUNTS OF SODIUM FLUORIDE CAPABLE OF PRODUCING FLUORINE CACHEXIA. (Quantites quotidiennes minima de fluorure de sodium capables de produire la cachexie fluorique). Text in French. Compt. Rend. Soc. Biol. (Paris), no.96:842-843, 1927.

Tests were carried out to determine, separately for each material investigated, the time required for different doses to cause death in guinea pigs. Daily sodium fluoride doses corresponding approximately to 1/10 of the dose caused cachexia which led to death after 2-3 mo, while doses of 1/50 of lethal dose were tolerated fairly well over more than 10 mo, and even the gain in weight was normal. Two animals treated with 1/20 of the lethal dose died after 118 and 98 days, respectively. Feeding experiments with fluorine contaminated feed revealed cachexia appearing during the second or third year.

39833

Dunning, James M.

EFFECTS ON ORAL STRUCTURES FROM AIR POLLUTION. Interdepartmental Committee on Air Pollution, Washington, D. C., Air Pollut., Proc. U. S. Tech. Conf., Washington, D. C., 1950, p. 503-506. (May 3-5, Louis C. McCabe, ed.)

Forty-two etiologic agents have been recorded as producing effects on oral structures, 18 of these agents are dusts and 12 are gases. Some of the agents cause physical damage such as staining or abrasion of the teeth, including copper, nickel, iron, chromium, coal dust, bone, celluloid, sawdust, flour, and tobacco. Chemical damage usually associated with some disease process may result from the heavy metals, fluorine, phosphorus, ionizing radiation, and sugar. Arsenic, chromium, phosphorus, and ionizing radiation produce syndromes characterized chiefly by soft tissue and alveolar necrosis. Bismuth, lead, and mercury greatly aggravate periodontal disease and usually produce gingival discoloration as well. Carbohydrate dust produces adherent plaques on the surfaces of teeth leading in time to dental caries. Most of these agents produce far greater effects upon already diseased oral structures than upon healthy ones.

39924

Cristiani, H. and P. Chausse

LATEST OBSERVATIONS ON CHRONIC POISONINGS WITH VERY SMALL SODIUM FLUOROSILICATE DOSES. (Nouvelles observations sur l intoxication chronique par de tres petites doses de fluosilicate de sodium). Text in French. Compt. Rend. Soc. Biol. (Paris), 1927:843-844, 1927.

Experiments carried out on guinea pigs with very small doses of sodium fluorosilicate are described. Amounts corresponding to about one-tenth of a lethal dose (0.50 g/kg body weight), admixed to food, caused death on the average after 18 days, without any signs of cachexia. Weight loss was 20%. Doses corresponding to 1/35 the lethal dose caused death after 51 days treatment, while 1/50 to 1/60 the lethal dose killed one animal after 233 days. That animal showed symptoms of fluorine cachexia and a weight loss of 40%. Thus, even small doses of sodium fluorosilicate were found to be much more toxic than sodium fluoride.

39931

Cristiani, H. and P. Chausse

LATEST OBSERVATIONS ON THE TIME REQUIRED FOR FLUORINE CACHEXIA TO APPEAR IN GUINEA PIGS FOLLOWING INGESTION OF DIFFERENT FLUORINE SALTS. (Nouvelles experiences sur le temps necessaire a l apparition de la cachexie fluorique chez les cobayes a la suite d ingestion de divers sels de fluor). Text in French. Compt Rend. Soc. Biol. (Paris), 1926:15-16.

Tests carried out on guinea pigs with different daily doses of various fluorine salts to determine the time required for lethal fluorine cachexia to appear are described. Alkaline fluorine salts in doses corresponding to 1/10 and 1/30 the lethal dose (0.50 g/kg body weight) caused death after 18 and 44 days, respectively. Animals treated with 1/35 the lethal dose (0.7 cg/day) of sodium fluoride died after 70 days (minimum 67, maximum 74 days), showing symptoms of fluorine cachexia. The same dose of sodium fluorosilicate caused death after 51 days (minimum 40, maximum 63 days). The data suggest that the time required for fluorine cachexia to appear increases with reduced doses. Feeding tests with very small doses (hay slightly contaminated with fluorine-containing dust) produced cachexia after 1-2 yrs.

40527

Tsunoda, Fumio

FLUORIDES AS AIR POLLUTANTS. PREVENTIVE TECHNOLOGY. POLLUTION IN ALUMINUM METALLURGY. (Fukkabutsu ai yoru taiki osen boshi gijuts no genjo to tenbo). Text in Japanese. Kinzoku (Metals) (Tokyo), 41(1):122-125, Jan. 1971. 9 refs.

Fluorine in the air easily reacts to dust, soot, and other inorganic matter. It is easily adsorbed by flue gas and reacts to vapor in the air to form hydrogen fluoride. Even the smallest amount of fluorides give a considerable damage to plants such as pine, iris, and gladioli. Furthermore, fluorides are accumulated in the plant leaves in polluted areas, and cause chronic fluoride poisoning of silkworms, cattle, and other animals that feed on such plants. The effects of fluorides in the air to human health is not severe if the content is on the order of the present 0.75 mg. However, fluoride can accumulate by consumption of agricultural produce grown in the areas that are polluted. There is a considerable amount of fluoride in rice and vegetables. Accumulation of fluoride taken over along period of time can cause chronic poisoning such as streaked teeth or hardening of bones. In the past, mass poisoning occurred in the area where natural ground water contained more than 1 ppm of fluorine or in crystal mines. Streaked teeth appear only when a child takes in a large dosage of fluorine daily between his infancy and 8 years old. Taking the same dosage after maturation does not cause streaked teeth. However hardening of bones will occur. Various methods of treating fluoride containing gas are reviewed. Spray tower, venturi scrubber, water jet scrubber, packed tower, and floating bed scrubber are compared. The most efficient are venturi scrubber and floating bed scrubber; but the operation is extremely costly.

40597

Flury, Ferdinand

DEATH CAUSE DURING THE FOG CATASTROPHY OF THE MEUSE VALLEY. (Die Todesursache bei der Nebelkatastrophe im Maastal). Text in German. Archiv Gewerbepathol Gewerbehyg., vol 7:117-125, 1936. 10 refs.

The 1930 fog catastrophy in the Meuse Valley is described and an attempt is made to determine the cause of the massive deaths which occurred. The meteorological conditions favored the formation of fog. An inversion at an altitude of 70-80 m and the vertical equilibrium led to persistent smog. The symptoms of irritation of respiratory organs, cough, and dyspnea, indicated local effects. Autopsies revealed congestion and diffuse reddening of mucous membranes in the trachea and bronchus, partial loss of the epithelium, alveolar edemas, and hemorrhagic foci. The death cause was undoubtedly severe pollution due to industrial gases, vapors, and aerosols accumulated in excessively high concentration. While the official statement which made the combustion products of coal sulfur chiefly responsible holds true, the massive deaths cannot be

satisfactorily explained from the inhalation of sulfur dioxide and trioxide and sulfuric acid bound in aerosols. Eye irritation was not frequent, and even the specific odor of sulfur dioxide was not present. Heart and circulation troubles in many cases indicated the high probability of the presence of other, resorptive toxic substances in the air. In view of the exceptionally high death toll in villages in the area of a plant emitting hydrofluoric acid at a daily rate of more than 2000 cu m, poisoning due to the inhalation of fluorine compounds may be regarded as most probable.

40635

Cavagna G, and G. Bobbio

CHEMICAL AND PHYSICAL CHARACTERISTICS AND BIOLOGICAL EFFECTS OF EFFLUENTS FROM AN ALUMINUM PLANT. (Contributo allo studio delle charatteristiche chimico-fisiche e degli effetti biologici degli effluenti di una fabbrica di alluminio). Text in Italian. Med. Lavoro (Milan), 61(2):69-101, Feb. 1970.

In 1932, three years after the Mori aluminum plant at Chizzola in the Italian province of Trento went into operation, school children observed round skin spots of a bluish color. By 1937, 786 such cases (the vast majority were children and women) were examined at the local clinic. No symptoms of fluorosis nor an elevated fluorine level in urine were observed. Bioptic examination of the cutaneous lesions revealed a great variety of different manifestations among them congestion of the deep dermo-hypodermic blood vessels, perivasal edema, and diapedesis of neutrophile granulocytes. After 1937, the phenomenon disappeared only to reappear again in July 1965. At Ziar and Hronom in Czechoslovakia another eluminum plant emitting times the amount of fluorine did not produce this phenomenon, even though fluorosis there was frequent. Also the Rheinfelden aluminum plant in Germany whose fluorine emission is 23 times that of the Mori plant did not produce the above phenomenon. To relate the appearance of the skin spots to fluorine emissions, dust from the Mori electrofilter was fed and injected subcutaneously to rats, mice, guinea pigs, and rabbits and the biological effects were studied by examining their capillary fragility. None of the anatomical, pathological, and biochemical parameters determined showed any difference between experimental and control animals. Thus, in the absence of any other explanation the phenomenon must be ascribed to the toxic or toxic-allergic effect of hydrofluoric acid and fluorides. Chemical analysis of the dust disclosed the presence of many elements in trace quantities, none of which could be relevant to the phenomenon.

40920

Takizawa, Yukio, Isamu Ogima, Yoshihiro Watanabe, Koji Sato, Setsuo Kuroda, Tatsuo Oshina, Ryuichi Sugai, and Shuji Yamashita

STUDIES ON EFFECTS OF AIR POLLUTION DUE TO FLUORIDES ON HUMAN BODIES IN NEIGHBOURING AREA OF ALUMINIUM MANUFACTURING FACTORY. (II). (Arumi kojo shuhen ni okeru fukkabutsu niyoru taikiosen no jintai ni oyobosu eikyo ni kansuru kenkyu. (II)). Text in Japanese. Kankyo Hoken Reporto (Environ. Health Rept.), no.8:53- 64, Jan. 1972.

The effects of fluorides on human health were investigated. Residents over 40 years old in a polluted area within 1 km from an aluminum factory in Naoetsu City and residents in a control area were examined on the basis of questionnaires concerning subjective symptoms, general physico-chemical examination, and for those who required closer examination, thyroid gland function tests, X-ray examinations of the bones, electrocardiogram, hematological examinations, and enzymatic function tests. The fluorine content in urine was significantly higher at the 0.5% level in the polluted area. The incidence of residents with 1.2 ppm of fluorine in urine tended to be high in the polluted area, but this was not statistically significant. Subjective symptoms, e.g., chronic bronchitis symptoms, exercise limitations and pains of the joints were recognized in the polluted area with high incidence. Closer examination did not determine any significant difference between the polluted and the control areas. Typical symptoms of chronic fluorosis, i.e., osteosclerosis and mottled teeth, were not established. However, proliferation or calcification of the bones was recognized regardless of area, sex, or age, Pulmonary fibrosis was observed in 65% of all subjects, with a higher incidence among residents near the factory. Thyroid gland function, the counts of erythrocytes and white blood cells, hemoglobin amount, and the values of GOT, GPT, and alkaline phosphatase did not establish any difference according to area or age.

41036

Higgins, E. Arnold, Vincent Fiorca, A. A. Thomas, and Harvey V. Davis

ACUTE TOXICITY OF BRIEF EXPOSURES TO HF, HCL, NO2, AND HCN WITH AND WITHOUT CO. Fire Technol., 8(2):120-130, May 1972. 13 refs.

Ten rats and 15 mice per group were exposed to a series of atmospheric concentrations of each test material to determine LC-50 (lethal concentration for 50% of the test animals). The animals were exposed in a dynamic flow system using a standard Rochester chamber modified to present the animals with a precisely timed 5-minute inhalation challenge. The animals were observed closely for 7 days following exposure in order to include among the observations any delayed deaths due to pulmonary edema. Hydrogen fluoride produced pulmonary edema of varying degrees of severity in most of the exposed animals. Delayed deaths were routinely seen with this compound in exposures below the LC-50 level of 18,200 ppm in exposed rats, with peak mortality occurring about 24 hr after exposure. Exposure of rats to hydrogen chloride resulted in LC-50 values of 40,989 ppm. The 5-minute toxicity from HCl was much less predictable than from HF. The 5-minute LC-50 value for nitrogen dioxide was 831 ppm for the rats. In hydrogen cyanide exposures, all deaths occurred during the exposure period or within 20 min after exposure. The LC-50 value for rats exposed to HCN was 503 ppm. Carbon monoxide concentrations not hazardous to life did not enhance the toxic effect of the four substances tested.

41224

Sadilova, M. S., K. P. Selyankina, and O. K. Shturkina

EXPERIMENTAL STUDIES ON THE EFFECT OF HYDROGEN FLUORIDE ON THE CENTRAL NERVOUS SYSTEM. Hyg. Sanit. (English translation from Russian of: Gigenia i Sanit.), vol. 30:155-160, May 1965. 1 ref.

On an experimental unit, which dosed the desired concentrations of hydrogen fluoride, the threshold volume of smell was determined and that of the reflex action of the substance on the functional state of the cerebral cortex by means of adaptometry. Both of these threshold values were at level on 0.03 mg/cu m. An all day round poisoning of albino rats for a period of 5 mo with HF at a concentration of 0.10 and 0.03 mg/cu m produced statistically significant functional changes in the central nervous system as revealed by the method of conditioned reflexes and chronaximetry. The neurohistological examinations, made at the end of the poisoning period in the area of motor and sensory analyzers, revealed lesions of the

interneural connections and nervous cells in the animals exposed to the action of HF at a concentration of 0.10 mg/cu m. The HF at a concentration of 0.01 mg/cu m produced no changes judging by both of the test studied. Taking into account the cumulative properties of fluorine, the maximum single and the average concentration of HF in the atmospheric air should not exceed 0.01 mg/cu m.

41684

Lindberg, Z. Y.

COMBINED EFFECT OF HYDROGEN FLUORIDE AND SULFUR DIOXIDE ON THE BODY OF MAN AND ANIMALS. In: American Institute of Crop Ecology Survey Of USSR Air Pollution Literature. A Second Compilation of Technical Reports on the Biological Effects and the Public Health Aspects of Atmospheric Pollutants. M. Y. Nuttonson (ed.), Vol. 11, Silver Spring, Md., American Institute of Crop Ecology, 1972, p. 14-23. Translated from Russian. (Also: Izv. Akad. Med. Nauk SSR, vol. 11:32-43, 1968.) NTIS: PB 209478

Experiments on the effects of sulfur dioxide and hydrogen fluoride alone and in combination on the olfactory threshold and on light sensitivity of the eye under dark adaptation conditions determined a complete summation of the effects of each substance. In rats that inhaled a mixture of 0.01 mg/cu m HF and 0.25 mg/cu m SO2 (inactive concentration of the mixture for short-term inhalation) and in rats exposed to a mixture of HF and SO2 at the level of maximum permissible concentrations (0.01 mg/cu m for HF and 0.15 mg/cu m for SO2), changes in the ratio of chronaxia of the antagonist muscles were significant. A histological examination of the organs of the animals showed significant changes in the lungs in the form of a thickening of the alveolar septa, areas of interstitial pneumonia, and emphysema. The combined presence of SO2 and HF in the air of populated areas at the level of the existing mean daily maximum permissible concentrations for each substance, therefore, is inadmissible.

41685

Sadilova, M. S., E. G. Plotko, and L. N. Yelnichnykh

NEW DATA FOR THE VALIDATION OF THE MEAN DAILY MAXIMUM PERMISSIBLE CONCENTRATION OF HYDROGEN FLUORIDE IN ATMOSPHERIC AIR. In: American Institute of Crop Ecology Survey of USSR Air Pollution Literature. A Second Compilation of Technical Reports on the Biological Effects and the Public Health Aspects of Atmospheric Pollutants. M. Y. Nuttonson (ed.), Vol. 11, Silver Spring, Md., American Institute of Crop Ecology, 1972, p. 24-32. Translated from Russian. (Also: Izv. Akad. Med. Nauk SSSR, vol. 11:5-15, 1968.) NTIS: PB 209478

The effects of hydrogen fluoride on the human organism were investigated to validate the basis for a standard maximum allowable concentration. Certain problems of the mechanism of the action of fluoride ions and the phosphorus-potassium metabolism using isotopic tracing were also studied. Two month old female rats were subjected to five-month continuous exposures to 0.10, 0.03, and 0.01 mg/cu m HF. Concentrations of 0.10 and 0.03 mg/cu m caused inhibition in the central nervous system, decreased the activity of a number of enzymes, impaired the phosphorus-calcium metabolism, and caused the accumulation of fluorine in the body and damage to the internal organs and bone tissue. The effects of the 0.01 mg/cu m were changes in the phosphorus metabolism only (inhibition of alkaline blood phosphatase and a delayed inclusion of radiophosphorus in bone tissue, liver, and blood at the end of the five-month exposure). A reduction in the mean daily maximum permissible concentration of hydrogen fluoride in the air of populated areas from 0.01 to 0.005 mg/cu m is suggested.

41686

Sadilova, M. S. and E. G. Plotko

SANITARY EVALUATION OF FLUORIDES READILY SOLUBLE IN BIOLOGICAL MEDIA. In: American Institute of Crop Ecology Survey of USSR Air Pollution Literature. A Second Compilation of Technical Reports on the Biological Effects and the Public Health Aspects of Atmospheric Pollutants. M. Y. Nuttonson (ed.), Vol. 11, Silver Spring, Md., American Institute of Crop Ecology, 1972, p. 33-41. Translated from Russian. (Also: Izv. Akad. Med. Nauk SSSR, vol. 11:16-26, 1968.) NTIS: PB 209478

The biological effects of fluoride salts, the solubility of different fluorides in biological media, and toxic thresholds of readily soluble fluorides were examined to establish a basis for a standard maximum allowable concentration. The highest solubility was displayed by sodium fluoride. Experimental data permitted the assumption that the NaF retained in the body dissolves completely in certain biological fluids. Aluminum fluoride, cryolite, and calcium fluoride will not dissolve completely in biological fluids and therefore may have a lesser toxic effect than hydrogen fluoride or 0aF. Light sensitivity of the eye among subjects exposed to concentrations of 0.07 mg/cu m increased; 0.05 mg/cu m concentration affected one person only. Chronic continuous exposure of rats over the course of five months to NaF concentrations of 0.10 and 0.03 jg/cu m determined a generally toxic effect and caused the accumulation of fluorine in the bone tissue. The extent of the changes was dependent upon the NaF concentration in the air. Because of the neutral properties of NaF dust and its incomplete absorption in the body after penetration through the respiratory organs, its toxic influence is less than that of similar hydrogen fluoride concentrations. The highest single NaF concentration in the air of populated areas should not exceed 0.03 mg/cu m, and the mean daily concentration should not exceed 0.01 mg/cu m.

41687

Sadilova, M. S.

BIOLOGICAL EFFECT OF POORLY POLUBLE FLUORIDES. In: American Institute of Crop Ecology Survey of USSR Air Pollution Literature. A Second Compilation of Technical Reports on the Biological Effects and the Public Health Aspects of Atmospheric Pollutants. M. Y. Nuttonson (ed.), Vol. 11, Silver Spring, Md., American Institute of Crop Ecology, 1972, p. 42-47. Translated from Russian. (Also: Izv. Akad. Med. Nauk SSSR, vol. 11:26-32, 1968.) NTIS: PB 209478

The biological effects of poorly soluble fluorides were studied to establish a basis for a standard maximum allowable concentration. Aluminum fluoride, a typical representative of poorly soluble fluorides, was selected for the study. The experiments were carried out with a condensation aerosol of AlF3 at a sublimation temperature of about 700 C. An AlF3 concentration of 0.3 mg/cu m caused a reliable increase of the light sensitivity of the eye in all the subjects. Chronic continuous exposure of two month old white female rats over the course of five months to koncentrations of 0.10 and 0.03 mg/cu m established a slight but statistically reliable prolongation of the chronaxies of extensors. The heavier concentration inhibited the activity of the blood cholinesterase. On the whole, exposure to both concentrations had only a slight toxic effect. In the atmosphere the highest single maximum permissible concentration of fluorides sparingly soluble in biological media is recommended at the level of 0.2 mg/cu m, with the mean daily value at 0.03 mg/cu m.

41688

Sadilova, M. S.

MATERIAL FOR STANDARDIZATION OF THE MAXIMUM PERMISSIBLE CONCENTRATION OF HYDROGEN FLUORIDE IN THE AIR OF POPULATED AREAS. In: American Institute yf Crop Ecology Survey of USSR Air Pollution Literature. A Second Compilation of Technical Reports on the Biological Effects and the Public Health Aspects of Atmospheric Pollutants. M. Y. Nuttonson (ed.), Vol. 11, Silver Spring, Md., American Institute of Crop Ecology, 1972, p. 48-60. Translated from Russian. (Also: Izv. Akad. Med. Nauk SSSR, vol. 10:186-201, 1967.) NTIS: PB 209478

The influence of varying concentrations of hydrogen fluoride on human subjects and on rats was studied and threshold levels were determined to establish a basis for a standard maximum allowable concentration. For the majority of subjects, the minimum olfactory perceptible concentration was 0.03 mg/cu m. In order to determine the effect of HF on the central nervous system via the receptors of the upper respiratory tract, the change in light sensitivity of the eye of three persons with normal vision was studied and determined the threshold concentration at 0.03 mg/cu m. Chronic continuous exposure of white female rats to 0.10 qnd 0.03 mg/cu m HF caused a number of disturbances in the animals, including the phenomena of inhibition in the central nervous system. A 0.10 mg/cu m concentration caused irreversible destructive changes in the nerve cells; changes in the phosphorus-calcium metabolism; accumulation of fluorine in the bone system; and histopathological changes in the teeth, bone system, and viscera. The 0.01 mg/cu m concentration caused no change in the experimental animals. The highest single concentration of HF, therefore, should not exceed 0.02 mg/cu m, and the mean daily concentration should not exceed 0.01 mg/cu m.

41706

Truhaut, Rene

DISHARMONY IN THE ENVIRONMENT. DANGERS OF THE CHEMICAL ERA. (Dysharmonie de l environnement. Dangers de l Ere Chimique). Text in French. Protecdo Vitae, 14(3):113-117, 1971. 10 refs.

Health aspects of food additives, household chemicals, and air pollution as well as general principles of the prevention of hazards, are reviewed. Various air pollutants, such as small particles, gases, and vapors may penetrate into the alveoli, cause local damages, and also enter the blood circulation. The major danger involved in air pollutants is long-term toxidity. The chief sources of carbon monoxide are firings and automobiles. Exhaust gas may contain 2.5-7% of CO. Sulfur dioxide plays an important role in the formation of acid smog. Nitrogen oxides are present in automobile exhausts, and nitrogen dioxide is necessary for smog formation. Exhaust gases contain unburnt hydrocarbons, and aromatic polycyclic hydrocarbons, such as benzo(a)pyrene, were detected in soot. Specific emissions from differnt industries are fluorine compounds, mineral dusts of vaious compositons, and odorous substances, e.g., mercaptan and amine derivatives. High concentrations due to unfavorable meteorological conditions or synergistic effects can result in acute toxic symptoms, while chronic toxicity may manifest itself as chronic bronchitis due to sulfur dioxide or fluorosis due to fluorine compounds. Increased incidence of bronchial cancer which may be caused by soot was observed in urban areas.

43277

Goldstein, Gerald

BIOCHEMICAL INDICATORS OF ENVIRONMENTAL POLLUTION. Preprint Oak Ridge National Lab., Tenn., Analytical Biochemistry Group, 39p., 1972. 176 refs.

Several studies related to the concept of biochemical indicators as monitors of environmental quality are reviewed. Several kinds of tissues and organs are potentially useful as indicators including plant tissues, various animal tissues, and blood. One study done with plant tissues showed that exposure to Peroxyacetyl nitrate, ozone, and fluorides inhibits the biosynthesis of cellulose due to the inactivation of phosphoglucomutase and cellulose synthetase. By studying various enzymes in fish, it is possible to determine the effects of pesticides and toxic metals. A dietary level of 5 ppm of DDT reduced the activity of glucose-6-phosphate dehydrogenase in rats. Guinea pigs were exposed to 15 ppm of nitrogen dioxide continuously for 10 weeks, and lung, liver, spleen, and kidney tissues subsequently examined. Lactic dehydrogenase and aldolase levels were elevated in most tissues. This indicates that chronic inhalation of air pollutants can cause alterations in tissue enzyme activity levels which can be detected and used as sensitive indicators. The measurement of cholinesterase activity in human blood plasma and erythrocytes can be used as an indicator of exposure to organophosphorus and carbamate pesticides. A decrease in the gamma-aminolevulinic acid dehydrase level may indicate exposure to lead. Nitrogen dioxide has been tested against mouse liver and rabbit and rat lung cell cultures. In the first case, increased cell mortality was observed and in the latter, a reduced oxygen consumption reflecting reduced cellular metabolism. Sulfur dioxide inhibits the growth of mouse liver cells and damages human lymphocytes in culture. Ozone inhibits the growth of human strain L cells. Peroxyacetyl nitrate inactivates isocitric dehydrogenase, glucose-6-phosphate dehydrogenase, and malic dehydrogenase within a few minutes. Ozone inactivates papain and glyceraldehyde-3-phosphate dehydrogenase. Atmospheric SO2 and 03 inactivate acetylcholinesterase.

43323

Horita, Hiroshi

POLLUTION AND TOXIC AND HAZARDOUS SUBSTANCES. GENERAL THEORY. (Kogai to doku kikenbutsu soronhen). Text in Japanese. Tokyo, Sankyo Shuppan, 1971, 240p. 76 refs.

Pollution, toxic and hazardous substances are discussed. Poisons are discussed, including acute and chronic poisoning, the effects in bodies, and the chemical structure. Air pollution problems are described in terms of sulfur dioxide, carbon monoxide, chlorine and chlorides, bromine, fluorine and fluorides, hydrogen sulfide, nitrogen oxides, ozone, hydrocarbons, particulates, soots, and radioactive substances. Soil pollution, river pollution, sea pollution, fires, and explosions are mentioned. Tables of plant damage by air pollution, threshold values of various polluters in drinking water, and a list of poisonous, combustible, and explosive compounds are included.

43636

Voisin, C.

ETIOLOGIC FACTORS IN CHRONIC BRONCHITIS AND PULMONARY EMPHYSEMA. (Les facteurs etiologiques dans la bronchite chronique et l emphyseme pulmonaire). Text in French. Rev. Med. (Tirgu-Mures), 11(37):2175-2176, 2178-2179, Oct. 1970.

Exogeneous and endogenous factors in chronic bronchitis and pulmonary emphysema are reviewed. Several factors overlap in their actions which makes it difficult to assess their respective contributions. Air pollution, primarily due to dust, soot, sulfur dioxide, nitrogen oxides, fluorine compounds, and oxidants, as well as smoking, particularly nicotinism, are the most important exogenous factors in chronic bronchitis and emphysema, while air pollution in occupational environment plays a minor role. Air pollutants cause irritation and hypersecretion of the mucous membranes, and reduce the resistance against microbial attacks. These exogenous factors are all the more dangerous when they combine with endogenous factors having produced constitutional predisposition. Such endogenous factors are age and sex, infections of the respiratory tract, allergies, genetic factors, hereditary immunity deficiency, mucoviscidosis, or alpha-l- antitrypsin deficit. The frequency of both chronic bronchitis and emphysema, higher for males than for females, increased with age. Infections of the respiratory tract facilitate the germination of germs in the subglottic tract, and the extension of lesions to the bronchioles or the parenchyma. Asthma is accompanied by bronchial hypersecretion in several cases, which may result in the combination of asthma with chronic bronchitis. Diverse genetic affections are accompanied by bronchial hypersecretion of chronic infection of the bronchi, or, less often, by emphysema.

43896

Martin, A. E. and Christine M. Jones

SOME MEDICAL CONSIDERATIONS REGARDING ATMOSPHERIC FLUORIDES. HSMHA (Health Serv. Ment. Health Adm.) Health Rep., 86(8):752-758, Aug. 1971. 28 refs.

In assessing margins of safety and possible toxic hazards from fluorides, it is necessary to consider the body s total intake of fluoride from all sources. The total intake will be derived in part from the diet, drinking water, and the atmosphere. The fluoride content of some individual foods is indicated, and the hazards to man from industrial fluorides are discussed. Air pollution by fluorides is considered, including man s fluoride intake from polluted air. The occurrence of fluorosis in cattle in the vicinity of factories emitting fluorides suggests a possibility of increased fluoride intakes in man arising from the contamination of food grown in these areas. Experiments indicate that man s comsumption of vegetables grown in such areas would not present a hazard to health, but in exceptional cases a grossly excessive consumption of heavily contaminated vegetables might lead to a slight increase in dental fluorosis in children. Such fluorosis, however, is unlikely, though experience from certain other countries indicated that where atmospheric pollution from fluorides is higher, signs of dental fluorosis may be found. Where necessary, a realistic assessment of the margin of safety or of the existence of a fluoride hazard may be obtained by adequate monitoring of pollution in the vicinity of any factory. (Author conclusions modified)

44362

Leloczky, Maria

STUDIES ON THE HEALTH-DAMAGING EFFECT OF THE FLUORINE-POLLUTION OF THE AIR AROUND AN ALUMINIUM FOUNDRY. (A levego fluorszennyezodesenek egeszsegugyi hatasa az inotai aluminiumkoho kornyeken vegzett vizsgalatok alapjain). Text in Hungarian. Egeszsegtudomany, vol. 15:74-80, 1971. 21 refs.

In the housing estate Varpalota-Inota, Hungary, where the air proved to be contaminated with fluorine, 227 children were examined. Fluorine was found in the urine of the children and in some cases at a level usually found in the urine of foundry workers. In a control area, where the air was free from fluorine, no fluorine was found in the children s urine. The hemoglobin level in the children at risk was low. In spite of these facts, a causal relationship between the fluorine pollution of the air and the levels of fluorine found in the urine was not established because fluorine is only one of the air pollutants around Varpalota-Inota. (Author abstract modified)

44589

Largent, Edward J.

INTRODUCTION. In: Fluorosis. The Health Aspects of Fluorine Compounds. Columbus, Ohio State Univ. Press, 1961, p. 1-2.

Fluorine is the most electronegative of all elements and one of the most violently reactive substances known to man. Since 1931, when fluoride was identified as the unique substance present in water that had caused mottled dental enamel in man, researchers throughout the world have been reporting on the osseous effects of fluorides, most frequently in cases of occupational exposure. A number of lawsuits alleging damage from fluorides were filed in 1944, stimulating greater interest in the investigation of the biological effects of fluorides.

44590

Largent, Edward J.

SKELETAL FLUOROSIS IN MAN. In: Fluorosis. The Health Aspects of Fluorine Compounds. Columbus, Ohio State Univ. Press, 1961, Chapt. 2, p. 8-21.

The results of various investigations into the health effects of fluorides in man, through occupational exposure and through water supply are summarized. The investigations reported were carried out between 1931 and 1949 in Copenhagen, North Africa, India, Argentina, South Africa, China, Scotland, and Texas and Oklahoma. The findings of these studies are examined concerning the establishment of a relationship between osseous deposition of fluoride and other observed disorders, such as hypertrophic bone changes and ligamentous calcification. Fluoride-induced bone changes that have been clearly demonstrated in man include increased radiopacity and hyperostoses in the forearm and leg, principally in the interosseous membranes. Ankylosing spondylitis or pokerback, or any other disabling change in the skeletal structures, have not been shown to have been caused in part or entirely by fluoride deposition. The changes seen clinically or radiologically in suspected cases of fluorosis are not pathogenomonic of that condition. For example, increased osseous density is observed in several bone diseases, and both calcification of ligaments and ankylosing spondylitis occur in other arthritic disorders. Moderate or advanced fluoride osteosclerosis may be suspected on the basis of demonstrated characteristic roentgenographic changes in the bones. Corroborative evidence as follows should be required in any case: proven absorption of fluoride amounting to 10 to 15 mg/day, or urine concentrations averaging more than 8 mg/l over a period of more than 5 years.

44593

Largent, Edward J.

CHRONIC FLUORIDE INTOXICATION IN ANIMALS. In: Fluorosis. The Health Aspects of Fluorine Compounds. Columbus, Ohio State Univ. Press, 1961, Chapt. 8, p. 74-89.

The dental effects in animals, as in man, are the first detectable response to exposure to relatively small amounts of fluoride. In the rat, bleaching of the orange colored enamel of

the incisors is first detected as alternate white and orange bands. The striation of the enamel has been detected in some incisors when fluoride was added to food in amounts as small as 7 ppm. Fluoride may effect the enamel of most animals only if it is fed prior to the eruption of the permanent teeth. At levels of ingestion somewhat above that required to cause mild dental fluorosis, the next most sensitive physiological response appears to be a reduction in the amounts of food eaten. At progressively higher levels, reduction in calf production, milk production, general condition, cachexia, organ degeneration, and death, appear in that order. Considerable experimental work has been done on the lower animals for the purpose of examining the mechanisms of skeletal storage of fluoride and fluoride excretion. At the highest tolerable levels of fluoride in food, the bones of animals will accumulate relatively large amounts of fluoride. Apparently, however, there is an upper limit of osseous deposition; fluoride in the ash of animal bones has rarely exceeded 3%, or 30,000 ppm. The average urinary fluoride limit, associated with earliest detectable skeletal abnormalities in cattle and sheep, is in excess of 40 ppm, the abnormalities appearing after one to two years of exposure.

44594

Largent, Edward J.

ACUTE FLUORIDE POISONING IN ANIMALS. In: Fluorosis. The Health Aspects of Fluorine Compounds. Columbus, Ohio State Univ. Press, 1961, Chapt. 9, p. 90-93.

Hydrofluoric acid is very corrosive and may produce serious local injury to the skin, cornea, and mucous membrane whenever it comes in contact with these tissues. Inhalation of elemental fluorine and of fluorides in sufficient concentrations has been fatal to animals. Exposures for periods of three hours at a concentration of 200 ppm, as well as briefer exposures at higher concentrations, were invariably fatal to exposed rabbits, guinea pigs, rats, and mice. At a level of 100 ppm, repeated exposure of these four species over a period of seven hours produced an over-all mortality of 60%. Severe damage to the respiratory tract was the only pathological change that developed consistently as a result of these fatal inhalations. Estimates of the minimum lethal dose for the soluble salts fall in the range of 45 to 90 mg/kg, expressed as fluoride ion when given orally to animals. The estimates for the lethal dose for dogs has been placed as low as 23 mg/kg. Signs of acute poisoning by ingestion are weakness, stupor, salivation, vomiting, thirst, convulsions, spasms, diarrhea, and increase in the frequency and depth of respiration, followed by paralysis. Albuminuria has also been observed and high concentrations of fluoride were found to have been excreted in the urine and in the saliva. Damage to tissues, caused by single massive doses or by repeated large doses of fluorides, is especially prominent in the gastrointestinal tract. Acute inflammation, hyperemia, swelling, bleeding, and epithelial degeneration have been reported. Acute fluoride poisoning has been reported to cause a sudden decrease in the numbers of formed elements in the blood, an inhibition of glycolysis, and a decrease in the concentration of calcium ions in the plasma. It is believed that the use of sodium fluoride for elimination of parasites in swine can be safely conducted without producing fatal acute poisoning.

44597

Largent, Edward J.

FLUORIDES AND OCCUPATIONAL HEALTH. In: Fluorosis. The Health Aspects of Fluorine Compounds. Columbus, Ohio State Univ. Press, 1961, Chapt. 12, p. 109-123.

Industrial uses of fluorides include processing of nuclear fuels and the manufacture of polymers, octane gasoline, plastic materials, fluorocarbon acids, oils, greases, pharmaceuticals, and nerve gas. In the form of cryolite, fluorides are used in large amounts each year in the manufacture of aluminum. The steel making industry depends heavily on fluorspar. The industrial activities in which rock phosphate is used probably liberate the greatest total amounts of fluoride. Sizeable quantities are also encountered in the following industries: glass, magnesium founding, cleaning of steel castings, welding, soldering, ceramic products, and in the disinfection of equipment in breweries. The responses of workmen to occupational exposure to fluorides are discussed with regard to the effects of fluorides on the skin, effects on the respiratory tract, absorption and excretion of fluorides, and osseous deposition of fluorides and changes in radiopacity. Inside industrial plants the level of fluoride in the air should not be allowed to exceed 3 ppm, expressed as HF, or to exceed 2.5 mg/cu m, expressed as particulate fluoride in air. If fluoride exposures are controlled so that no workman repeatedly excretes fluoride at a level as high as 8 mg/l of urine, there is very little likelihood that any ill effects will result from exposure, although a slight increase in osseous radiopacity may, in rare instances, develop after many years of occupational exposure.

44867

Ruiz Salazar, Antonio and Alejandro Castanedo

PATHOLOGICAL CONDITIONS CONNECTED WITH THE OIL INDUSTRY. (Patologia de la industria del petrolio). Text in Spanish. Med. deporte trab., 18(128):560-581, 624-641, 674, 1953. 30 refs.

Petroleum processing plant-induced pathology is reviewed. Toxicology is analyzed in terms of effects produced by oil impurities (hydrogen sulfide), ingredients applied for the improvement of fuels (hydrofluoric acid and tetraethyl lead), and by the petroleum hydrocarbons themselves. Petroleum distillation generates air pollutants such as ethane, propane, and butane. But most of the petroleums are considered to be non-toxic. Gasoline cracking, however, produces toxic non-saturated compounds. Reference is made to an accident which occurred in 1922 under atmospheric inversion conditions in a settlement close to the A.G. V.I. processing plant. Fatalities were attributed to the action of carbon dioxide and/or H2S. Another air pollution accident which occurred in 1950, due to the deterioration of an emission control unit, is attributed to the large amounts of H2S in the air. The accident caused 22 deaths and more than 300 poisoning episodes. Autopsies revealed the lungs to be the most affected organ under the circumstances. Victims with tetraethyl lead poisoning were found with brain and lung congestion, and minor inflammation of the other internal organs. Chronic TEL poisoning is characterized by asthenia, anemia, arterial hypotension, and loss of weight. Hydrofluoric acid is described in terms of acute effects due to its high respiratory tract irritation activity. Dermatoses are the most diffused diseases due to chronic exposure to petroleum. The petroleum industry has no causal connection with tuberculosis. The pathology of chronic exposure to the petroleum industry requires systematic studies in order to provide the appropriate control measures.

45055

Sadileva, M. S. and A. A. Petina

HYGIENIC SIGNIFICANCE OF LOW FLUORINE CONCENTRATIONS FOR DIFFERENT ROUTES OF INTAKE. (O gigienicheskom znachenii malykh kontsentratsii ftora pri razlichnykh putyakh postupleniya v organizm). Hyg. Sanit. (En-

glish translation from Russian of: Gigiena i Sanit.), 35(8):184-187, Aug. 1970. (Includes discussion by Gabovich, R. D. in Hyg. Sanit. (English translation from Russian of: Gigiena i Sanit.), 36(5):270-272, May 1971.) NTIS: TT 70-50048/3 and TT 71-50122/2

To assess the various routes of entry of fluorine into the body a series of experiments on albino rats was carried out lasting for 5 months: using water containing fluorine at a concentration of 1.0- 1.5 mg/l; 24-hr inhalation poisoning of animals with low concentrations (0.1, 0.03, and 0.01 mg/cu m); and simultaneous action of fluorine contained in water at concentrations of 1.0-1.5 mg/l and that inhaled at a concentration of 0.01 mg/cu m. A study of functional, biochemical and morphological changes developed proved nonorganic fluorides, entering the body through the respiratory organs, to be much more toxic than the equivalent quantities of fluorine, introduced into the body with water. In the case of long-term inhalation of air with an admixture of small concentrations of fluorides, the primary changes developed in the body at an optimal content of fluorine of 1.0 mg/l. This fact points to the necessity of using highly effective means of decontamination of industrial fluorine discharges into the atmosphere. A critique by a scientist not involved in these particular experiments points to several uncontrolled variables in the methods employed. It is further suggested that on the basis of observations on three groups of human volunteers, there is no significant difference in the effects on man of fluorides between peroral and respiratory administration. (Author summary modified)

45683

Sakabe, Hiroyuki, Kiyoyuki Kawai, Ayanori Sauda, Kimiko Oki, Katsunori Honma, and Heihachiro Arito

THE TOXICITY OF EMISSIONS FROM HEATED REFRACTORY HIGH POLYMER COMPOUNDS. (NO. 3). (Tainetsusei kobunshi kagobutsu no kanetsu ni yoru seiseibutsu no dokusei ni tsuite.) (sono 3). Text in Japanese. Sangyo Igaku (Jap. J. Ind. Health), 14(4):130-131, July 1972.

The toxicity of emissions from heated teflon was investigated. In 10 minutes, 0.72 g of polyfluoroethylenepropylene (PFEP) heated at over 500 C vanished; mice exposed to the emissions all died in the same period of time. More than 150 ppm of hydrogen fluoride gas was detected. At 350 C, only 3% of the sample PFEP vanished; mice exposed to emissions showed light symptoms of poisoning, e.g., difficulty of breathing and decrease in body weights. Mice exposed to emissions from polytetrafluoroethylene heated at 400 C died in 48 hours. When a filter which reduced more than half of the fluorides in the emission was used, only slight decreases of body weights were noted.

46085

Truhaut, Rene

DANGERS OF THE CHEMICAL AGE. (Dangers de l ere chimique). Text in French. Chim Ind., Genie Chim., 105(3):239-249, Feb. 1972. 10 refs. (Presented at a Conference in the Centre de Perfectionnement Technique.)

The necessity of understanding the dangers of the chemical age is emphasized; examples of toxic risks in different fields are provided; and the main principles of prevention of these dangers are discussed. Toxicity may take the form of acute, sub-acute, short-term, and long-term intoxication. Particular attention should be paid to exposure to poisons possessing cumulative properties. Various toxic substances such as lead, cadmium, mercury, and fluorides have different forms of absorption and excretion. Human and environmental factors likely to have a qualitative or quantitative effect on toxicity and on the conditions under which it reveals itself are considered. There are risks in using chemicals in medical treatment. The presence of pharmaceuticals in the home is not always safe, especially in the case of unusual response of certain organisms to medicines. Fatalities have occurred due to overdosage or erroneous labelling. Workers are more exposed to chemical agents both in industry and agriculture (pesticides). Another major risk is posed by deliberate or accidental addition of chemical agents to foodstuffs and water. The general population is exposed to air pollution in the form of carbon monoxide, hydrogen sulfide, nitrogen oxides, and hydrocarbons. Other risks are related to the use of chemicals in cosmetics and household products. These risks can be minimized by setting purity standards for chemicals, labeling the development of toxic pathology or poison-treatment centers, and the establishment of concerning admissible limits for pollution in working atmospheres or urban air.

47807

Oelschlaeger, Walter

THE EFFECT OF POLLUTANT EMISSIONS ON DOMESTIC ANIMALS. (Immissionen und ihre Wirkung auf landwirtschaftliche Nutztiere). Text in German. Umweltforschung, no. 58:26-29, 1971. (Presented at the Hohenheim University Umweltforschung Seminar, 1971.)

General problems of the effects on livestock of various pollutant emissions are reviewed. Livestock damage is mostly due to the ingestion of forage contaminated with toxic substances such as arsenic, chromium, cadmium, molybdenum, copper, fluorine, and lead. Fluorine emission-generated livestock damages in Germany have abated for the last years as a result of the implementation of strict emission standards. Though lead concentrations in plants near highways, especially within the nearest 100-meter strip, are essentially above average, the consumption of such forage by livestock is usually occasional, and hence no damage should be feared. Lack of appetite, diarrhea, loss of weight, sometimes infertility, and reduced milk yield in cows are the nonspecific symptoms of poisoning in livestock. The meat from such animals is usually fit for consumption, while milk lead concentrations may be sometimes too high to be acceptable.

47905

Takizawa, Y., I. Ogima, S. Kuroda, and T. Oshina

THE EFFECT ON THE HUMAN BODY BY FLUORIDE AIR POLLUTION. (Fukkabutsu ni yoru taikiosen no juntai no oyobosu eikyo). Text in Japanese. Nippon Koshu Eisei Zasshi (Japan. J. Public Health), 19(10):425, Oct. 1972. (Presented at the Japan Society of Public Health, General Meeting, 31st, Sapporo, Japan, Oct. 25-27, 1972.)

Subjects were 1210 children aged between 3 and 15 and 1147 subjects out of 1210 who were living in an area within 1 km of an aluminium refinery factory; 63 were chosen for comparison. The average fluoride content in urine of the subjects of the comparison group was 0.180 ppm and the subjects of the polluted area showed a remarkably high value of fluoride. As a result of the second examination, curvature of the ulna, early choosing of epiphysia line were found 9.3% of subjects, pulmonary fibrosis was found 4.1% of subjects, bronchitis was 9.7% and asthma was 3.2%. Twenty-four subjects were hynoplastic dental enamel.

47906

Tsuji, Y., H. Kunida, Y. Honma, I. Watanabe, and K. Matsuura

RELATION BETWEEN AIR POLLUTION DUE TO FLUORIDE AND SWELLING OF THE THYROID GLAND IN KITAKATA CITY (FUKUSHIMA PREFECTURE). (Fukkabutsu niyoru kankyoosen to kojosen shucho). Text in Japanese. Nippon Koshu Eisei Zasshi (Japan. J. Public Health), 19(10):426, Oct. 1972. (Presented at the Japan Society of Public Health, General Meeting, 31st, Sapporo, Japan, Oct. 25-27, 1972.)

There is an aluminum refinery factory in Kitakata. This city was divided into several sections. The area nearest to the factory was the most polluted area (fluoride content in air was 173.6 + or - 24.2 kg/sq m/mo). Subjects were primary school children of this polluted area. The result was that 193 children out of 339 showed symptoms of swelling of the thyroid gland. But this result doesn t mean the mutual relation between air pollution due to fluoride and swelling of the thyroid gland becau e even in an area which was not polluted by fluoride, there sometimes were examples of swelling of the thyroid gland. More examinations on this subject are required.

48030

Borsdorf, Wolfgang

DAMAGE OF FLUORINE-INDICATOR PLANTS IN THE WILD FLORA. Wiss. Z. Tech. Univ. Dresden, 11(3), 1962. (Presented at the International Research Congress of Forest Experts in Smoke Damage, 3rd, Tharandt, Germany, May 24-27, 1961.) Translated from German. 2p.

In an area of central Germany which has a high concentration of fluorine-containing exhaust gases, the wild flora and some cultivated plants were examined in order to determine their adequacy as indicators for fluorine damage. Three years of observations resulted in a list of 59 kinds of plants, subsequently divided into four sensitivity groups on the basis of macroscopic damage such as necrosis of the edges of the leaves. In general, the gramineea and Polygonacea seemed to be sensitive, while the Liabiates, composites papilionacea crucifers, and Umbelifera were very resistant. The amount of damage was also influenced by topographic and meteorological factors.

48068

Deutsches Zentralinstitut fuer Arbeitsmedizin, Berlin (East Germany)

INDUSTRIAL TOXICOLOGY PART II: TOXIC GASES. (Industrietoxikologie II: Toxische Gase). Text in German. In: Arbeitswissenschaftliche Lehrbriefe. Rept. 14/15/16, p. 87-97, 1971 (?).

General toxicological description is given of the most common industrial toxic gases. Gases such as fluorine, chlorine, bromine, and their compounds, as well as phosgene, sulfur dioxide, nitrogen oxides, and ammonia have predominantly irritating effects, while others, such as carbon monoxide, carbon dioxide, acetylene, ethylene oxide, metal carbonyls, hydrocyanic acid, hydrogen sulfide, and hydrogen selenide interfere with metabolic processes. Pulmonary edema, fibrosis, bronchopneumonia, and ocular conjunctivitis are the symptoms of fluorine and hydrofluoric acid. Phosgene, decomposing into hydrochloric acid and CO, damages certain organs, the central nervous system, and interferes with enzymatic processes. Sulfur dioxide causes irritation of the respiratory tract, cough, vomiting, and pulmonary edema. Nitrogen ozides irritate moist mucosa, and cause pulmonary edema, dyspnea, vomiting, asthenia, unconsciousness, and possibly death or pulmonary complications. Ammonia represents a strong irritant for the mucosa, particularly of the eyes. Carbon monoxide, blocking hemoglobin, causes headache at carboxyhemoglobin contents above 25%, and psychic damages at contents of 30-50%, 75-80% concentration is lethal. Damages to the cardiovascular and vegetative nervous systems, and impaired vision and hearing due to chronic poisoning, have been observed. High concentrations of carbon dioxide cause headache, dizziness, asthenia, and damage to the central nervous system. Nausea, vomiting, and narcosis are the basic symptoms of poisonings with ethylene oxide. Hydrogen sulfide and hydrogen selenide irritate moist mucosa, damage enzyme systems, and may cause sudden death. Hydrocyanic acid interferes with the oxygen metabolism in the cells.

48636

Takizawa, Y., I. Ogima, Y. Watanabe, S. Kuroda, and T. Oshina

THE EFFECT OF AIR POLLUTION DUE TO FLUORIDE ON THE HUMAN BODY - THE THIRD REPORT. (Alumi kojo shuhen ni okeru fukkabutsu ni yoru taiki osen no jintai ni oyobosu eikyo ni tsuite - dai sanpo). Text in Japanese. Kankyo Hoken Reporto (Environ. Health Rept.), no. 16:59-71, Dec. 1972.

A group of 1210 infants, children, and 1147 students aged between 3 and 15 living within 1 km of a factory which produced fluorides (A group) and 63 subjects for comparison (B group) were studied. The first examination studied subjective symptoms and teeth. The fluorine content in urine was 0.181 ppm in A group and 0.391 or 0.408 ppm in B group; this value was higher in boys than in girls. The most frequent subjective symptoms which the subjects complained of were respiratory symptoms especially cough and phlegm. Dysodontiasis or insufficiency of calcification were observed 20.2% of A group. The second examination was done on the subjects who had fluorine in the urine over a 0.42 ppm concentration and who showed other symptoms and on the subjects whose fluorine content was under 0.42 ppm but who showed the symptom of dysodontiasis. The average fluorine content in the urine was 0.358 and 0.204 ppm, respectively; these values were less than the content of the first examination because this examination was done before a meal.

48637

Takizawa, Y., I. Ogima, Y. Watanabe, S. Kuroda, and T. Oshina

THE EFFECT OF AIR POLLUTION DUE TO FLUORIDE ON THE HUMAN BODY - THE FOURTH REPORT. (Alumi kojo shuhen ni okeru fukkabutsu ni yoru taiki osen no jintai ni oyobosu eikyo ni tsuite - dai yonpo). Text in Japanese. Kankyo Hoken Reporto (Environ. Health Rept.), no. 17:69-89, Dec. 1972.

A third examination was made of 74 children and infants who showed symptoms of pulmonary fibrosis, who were diagnosed as bronchitis or asthma patients, or who showed dysodontiasis. The fluorine content in the urine of boys (38 cases) was 0.500 ppm and that of 34 girls was 0.484 ppm. The highest value was 1.5 ppm of a girl, and four cases were over 1.0 ppm. As a result of a dental examination, a mild insufficiency of calcification was observed 10 cases and moderate one in six cases. The respiratory diseases were not observed. As a result of a heart examination, myocardosis was found in two cases and enlargement of cardiac ventricle in one case.

48693

CAN FLUORIDE CAUSE LUNG CANCER? Fluoride, 5(4):169-171, Oct. 1972. 14 refs.

The possible carcinogenic role of the fluoride ion is discussed, and studies on fluoride emissions in relation to lung cancer are summarized. The results of the studies are necessarily limited, but cannot be discounted. Even if fluorides are not solely responsible for the development of lung cancer, in conjunction with other carcinogens they might act as a synergist. Fluoride is also a constituent of asbestos, a recognized carcinogenic agent, at levels of the order of 70-579 ppm.

48697

Cecilioni V. A.

LUNG CANCER IN A STEEL CITY. ITS POSSIBLE RELATION TO FLUORIDE EMISSIONS. Fluoride, 5(4):172-181, Oct. 1972. 21 refs. (Presented at the International Society for Fluoride Research, Annual Conference, 4th, Hague, Netherlands, Oct. 24-27, 1971.)

The epidemiology of 300 deaths from primary lung cancer in the industrial steel city of Hamilton, Ontario was studied. A breakdown of the city into zones revealed three different rates directly related to the proximity to the main industrial area, with a high of 65 per 100,000 population in the northeast end close to the steel mills, a low of 12 in the most distant section, and 23 in the intermediate zone. A marked rise in steel production and a corresponding increase in the use of fluorspar flux occurred during the same period (1966-68). Characteristic fluoride damage to vegetation was established, especially in the northeast section. Analyses of vegetation, dust, and human bones determined high levels of content of fluoride, sulfur, and silica. (Author summary modified)

49164

Takizawa, Yukio, Isamu Hagima, Yoshihiro Watanabe, Tatsuo Oshina, and Setsuo Kuroda

EPIDEMIOLOGICAL STUDIES OF FLUORIDES EFFECTS ON THE HUMAN BODY, 2ND REPORT. (Fukkabutsu no jintai ni oyobosu eikyo no ekigaku-teki kenkyu, Dai-2-ho). Text in Japanese. Kankyo Hoken Reporto. (Environ. Health Rept.), no. 13:69-80, Sept. 1972. 1 ref.

A complete and detailed report is presented on the findings of the third examinations of the 15 patients who were screened by two previous health examinations of 1152 people living 1 km from a chemical factory in Niigata Prefecture. Examinations were given to find out their awareness of symptoms, general clinical diagnoses, dental conditions, baxic metabolism, cardiogram, hematological conditions, enzyme functions, fluoride content in their urine, and the chest and bone x-ray results. The total discovery rate of all the examinees was 7.5%. Most people had some form of complaints such as coughing and gagging (69.2%), sputum (69.2%), rhinitis (61.5%), wheezing (53.8%); these symptoms worsened in southerly winds (42.2%). Other common symptoms were exhaustion, toothache, palpitation, and skin damage. All 15 patients originally had more than 1.2 ppm F content in their urine, but in this third test, only three had more than 1.2 ppm, and the average was 0.853 ppm. The chest X-ray showed that 10 persons had the shadows of lung fibrosis. Other X-ray findings were abnormality of the hip bone on six persons and a suspicion of the same on one person; irregularities on other parts such as the knees, pelvic bones, elbows, and hands were recognized on several patients. Altogether, 84.6% of the patients (11 persons) showed some form of abnormality in their bone formation. The general clinical test showed that 10 persons had high blood pressure, seven had chronic bronchitis, and two had bronchial asthma and skin disease.

49223

Griffiths, J. E.

ACUTE INHALATION AND DERMAL APPLICATION SCREENING STUDIES OF 2,4,6-TRIFLUORO-SYM-TRIAZINE AND 2,4,6-TRIS(TRIFLUOROMETHYL)-SYM-TRIAZINE. Am. Ind. Hyg. Assoc. J., 33(6):382-388, June 1972. 7 refs.

Screening studies of the effects of acute inhalation of 2,4,6-trifluoro-sym-triazine ((FCN)3 -- known as cyanuric fluoride) and of 2,4,6-tris(trifluoromethyl)-sym-triazine ((CF3CN)3) on male albino rats are reported. Values for LC50 of 3 ppm for cyanuric fluoride and 1400 ppm for 2,4,6-tris-(trifluoromethyl)-sym-triazine were found. Acute dermal application studies of the same two chemicals on rabbits are also reported. The lethal dose 50 values of 100 microniters/kg of body weight for cyanuric fluoride and more than 1000 microliters/kg of body weight for (CF3CN)3 were established. The cyanuric fluoride was particularly insidious because of its high skin permeability. Data on human response to either chemical it not well documented and therefore is quite subjective. Small quantities as low as about 1 to 5 ppm of cyanuric fluoride can be detected from its pungent odor before other body senses respond. At higher levels, burning of the eyes and breathing discomfort are readily apparent. The properties of cyanuric fluoride and (CF3CN)3, and data on the effects of both chemicals on the trachea, lungs, liver, spleen, and kidneys of rats are given.

49271

Tsuji, Yoshito, Hiroko Kunita, Yasuo Homma, Iwao Watanabe, and Matsuura Kiyokatsu

THE CHANGES OF THYROID OF CHILDREN IN FLUORIDE-POLLUTED AREAS. (Fukkabutsu ni yoru kankyo osen to kojosen shucho). Text in Japanese. Japan Society of Air Pollution, Proc. Symp. Japan Soc. Air Pollut., 13th, 1972, p. 201. (Nov. 7-9, Paper 156.)

The pollution from an aluminum refining factory has been investigated for several years. In this report, air pollution by fluorides between Jan. and Dec. 1971 and thyroid gland swelling were examined. Fluoride content in the air was sampled with the rain water collected in deposit gauges. Children of two elementary schools were given health and dental examinations, and the frequency of the swelling of the thyroid and maculosa teeth were studied. There were some occurrences that could suggest the effects of fluoride pollution. But there were instances of swelling of the thyroid and maculosa teeth in unpolluted areas also, and the examples were too few to relate the instances with the fluoride pollution.

49448

Bittel, Robert and Bernadette Vaubert

PROBLEMS INVOLVED IN THE PREVENTION OF FLUORINE AND FLUORINE COMPOUNDS-GENERATED HAZARDS. (Analyse des problemes de protection posés par le fluor et les composes fluores). Text in French. Centre d Etudes Nucleaires, Fontenay-aux-Roses (France), Dept. de Protection, 54p., June 1971. 81 refs. NTIS: CEABIB200

General problems of the hazards involved in and the effects on man, animals, and plants of fluorine and its compounds, as well as the possible sources of fluorine emissions with special regard to fission fuel processing and nuclear engineering are

reviewed. Fluorine and its compounds, either ingested or inhaled, are carried by the blood to different organs such as the kidney, and are eliminated relatively rapidly in urine. Gastrointestinal, cardiac, and renal damages, pulmonary edema, convulsions, and irritation of the respiratory tract are typical symptoms of acute fluorine poisoning. Fluorosis due to chronic exposure to fluorine and its compounds manifests itself in bone and tooth damage, gastrointestinal troubles, and asthma. Unlike cattle, humans are relatively insensitive to fluorine intake. Colchicum automnale, Lilium sp. cultivar, Iris germanica and Vitis vinifera L. are among the most fluorine-sensitive plant species. Physical and chemical properties, as well as metabolic mechanisms of various fluorine compounds are described.

49607

Tsunoda, Fumio, Ekuko Aizawa, Shiro Sakurai, Hiroko Kunida, and Kazuo Sasaki

ON THE FLUORIDE BODY BURDEN OF RESIDENTS LIVING IN FLUORIDE POLLUTED AREAS. (Taiki-chu fukkabutsu ni yoru kankyo osen chiku jumin no seitai osen ni tsuite). Text in Japanese. Japan Society of Air Pollution, Proc. Symp. Japan Soc. Air Pollut., 13th, 1972, p. 199. (Nov. 7-9, Paper 154.)

The fluorine pollution of the living body checked by the urine test is discussed. When a solution of fluoride is taken orally, an increase of fluorine content in the plasma is noted in 15 min, and the index reaches a peak in 30 min, then drastically reduces. Approximately 15% of orally taken fluorine is excreted in the urine in 1 hour, 25% in 2 hours, 43% in 3 hours, and more than 50% of the consumed fluorine is excreted in 12 hours. When examining the in-vivo effects of fluorine by urine samples, spot sampling is not enough, but continuous tests are necessary. According to the 24-hour samplings of people living in a fluorine polluted area, in more than 1 l of urine averages of 2.05 plus or minus 0.30 mg/person of F for 13 men, and 1.77 plus or minus 0.43 mg of F for 17 women were excreted. A similar test was given to people in an unpolluted area, and averages of 0.79 plus or minus 0.07 mg/person for nine men and 0.73 plus or minus 0.07 mg for 13 women were excreted in 24 hr. The difference was conjected to be the amount of fluorine residues in the agricultural produce gathered from the environment. The results of an examination of teeth fluorosis in a polluted area is briefly mentioned.

49756

Ordonez, Blanca Raquel

THE EFFECTS OF AIR POLLUTION ON HUMAN HEALTH. (Los efectos de la contaminacion atmosferica en la salud del hombre). Text in Spanish. Salud Publica Mexico, 14(2):209-216, March-April 1972. 38 refs. (Presented at the National Security Congress, Mexican Hygiene and Security Association, Nov. 1971.)

Effects of air pollution on human health are reviewed and illustrated by the famous accidents which occurred in London, the Meuse Valley, in the U. S., and in Japan. Meteorological (humidity, temperature inversion, solar radiation), geographical, and biological factors enhancing the damaging effects of air pollution on whole populations are discussed. Pollutants are divided into irritant and absorption agents according to their action target. Irritant pollutants can be divided into reducing (sulfur dioxide and dust particles) and oxidizing agents such as ozone and nitrogen oxides. Agents acting upon absorption include carbon monoxide, lead, 3,4-benzopyrene, polynuclear hydrocarbons, and fluorides. The action of SO2 and dust particles on the respiratory tract is strongly interrelated, and the effect of the former is catalyzed by the latter. Both effects are enhanced by atmospheric humidity since respiratory symptoms appear to be more severe under fog conditions. Epidemiology data indicate that chronic bronchitis patients are even more susceptible to the above and to oxidizing agents. Carbon monoxide effects include formation of carboxyhemoglobin interfering with tissue respiration processes. Inhalation of larger CO amounts may cause death upon failure of the central nervous system. People suffering from heart disease or severe anemia are most susceptible to CO. Lead interferes with the hemoglobin synthesis processes and causes kidney and liver damage, fertility impairment, and mental retardation in children. Benzo(a)pyrene is known to be carcinogenic in laboratory animals and in occupationally exposed workers; however, no correlation between benzo(a)pyrene, emitted by automotive vehicles and lung cancer could be established. The lack of studies relating pollution and health hazards in Mexico is emphasized.

50161

Kuehnert, M.

EMISSIONS AND THEIR IMPORTANCE FOR CATTLE BREEDING AND HUMAN HEALTH. (Immissionen und ihre Bedeutung fuer die Tierproduktion und die menschliche Gesundheit). Text in German. Z. Ges. Hyg. Ihre Grenzgebiete (Berlin), 19(2):89-98, Feb. 1973. 28 refs. (Presented at the Gemeinschaftstagung der Gesellschaft Allgemeine und Kommunale Hygiene der DDR undder Wissenschaftlichen Gesellschaft fuer veterinarmedizin der DDR, May 8-15, 1972.)

The effects of fluorine, carbon monoxide, metals such as lead, mercury, and arsenic, and hydrocarbons on cattle and man are reviewed, and data on maximum allowable emission concentrations for these substances in the U. S. are listed. In the German Democratic Republic the emission regulations of June 28, 1968 include maximum allowable emission concentrations for various pollutants, e.g., lead 0.0007 mg/cu m (24 hour value); fluorine 0.01 mg/cu m, sulfur dioxide 0.15 mg/cu m, and oxides of nitrogen 0.1 mg/cu m. Fluorine injuries of a chronic nature were witnessed in East Germany. In young cattle the following F concentrations were measured, lower jaw bone (teeth) 2700 ppm, ribs up to 3500 ppm. Retarded growth and lower milk production were also noticed. The lead contamination of cattle in the Mannsfeld and Freiberg areas is mainly due to automobile exhausts. In Poland the arsenic emission in the vicinity of a power plant fired with coal was measured to be 1 t/day. A maximum concentration of 69 micrograms As/cu m was repeatedly measured. Within a radius of 30 km an extensive bee kill was noticed. The government gives the problem of air pollution exposure of humans and cattle great attention. In the centers of the chemical industry such as Bitterfeld, Leuna, and Buna, the development of processes producing a low amount of pollutants is given high priority in the 5 year-plan. The SO2 and dust emission will be reduced by the erection of a new power plant serving the chemical industry in Bitterfeld operated with natural gas. Electrostatic precipitators are used to reduce pollution from the Buna power plant.

50318

Niigata Prefectural Research Inst. for Public Nuisances (Japan)

NIIGATA PREFECTURAL HYGIENIC AND PUBLIC NUISANCE LABORATORY ANNUAL REPORT. (Niigata-ken eisei kogai kenkyusho nenpo). Text in Japanese. Rept. 6, p. 40-41, 1971.

The measurements of sulfur dioxide, suspended particulates, soot, fluoride, automotive exhaust gases, fluoride ion, nitric oxide, nitrogen dioxide, and hydrogen fluoride, for Niigata Prefecture are presented. The fluoride and sulfur content in 426 samplings of cedar leaves are compared. The leaves from the most damaged areas showed significant differences of F content by age; the greatest amount was found in new leaves, followed by 1 year leaves, 2-year leaves, and dead leaves. But in the areas with slight damages, there was no significant difference in the age of leaves and the amount; slightly higher F content was found in dead leaves. The fluoride ion content in urine was measured from the samplings of 958 children in polluted areas and 61 children in non-polluted areas. The total average in non-polluted areas was 0.17 ppm, and that of the polluted area was 0.43 ppm. The average of the infants in the polluted areas was 0.38 ppm, elementary schoolchildren 0.41 ppm, and junior high school pupils 0.38 ppm.

50371

Takizawa, Yukio

EFFECTS OF FLUORIDE FROM ALUMINUM REFINING MANUFACTURE IN MAN-NAOETSU LITTORAL INDUSTRIAL AREAS. (Niigata-ken Naoetsu rinkai kogyo chitai ni okeru fusso ni yoru jintai eikyo ni tsuite). Text in Japanese. Kogai to Taisaku (J. Pollution Control), 9(4):339-346, April 1973. 21 refs.

The chronic effects of fluoride pollution on the human health were examined thoroughly in the Naoetsu Coastal Industrial Area, near Mitsubishi Chemical Plants. Examinations were given on the general health, teeth, respiratory system, and urine on the primary level, and on the secondary level, blood, basic metabolism, cardiograph, and X-ray images were examined. The tests were started in Nov. 1970 and completed before Aug. 1972. The adult urine in two polluted areas had averages of 0.813 ppm and 0.759 ppm, and in control area 0.574 ppm. Among children, the averages were 0.391 and 0.408 ppm in polluted areas, and 0.180 ppm in the control area. The significant difference was greater among children than among adults. The frequency of incomplete or irregular enamel formation of teeth among children (3-15 yr) was 198/982 in polluted areas (20.2%), and 11/61 (18.0%) in he control area. For the examination of mottled teeth, all the malformation of enamel layers suspected of other factors than pollution were eliminated. Ten mottled teeth of a light degree and six advanced cases were recognized among 198 children with irregular enamel formation. There were five slight cases of mottled teeth in the control area. The ratio of cavities on permanent teeth was 69% in polluted areas and 82% in non-polluted area. The X-ray tests showed that 11 among 57 adults (19.3%) had abnormal bone formation. Symptoms like chronic bronchitis were complained of by 44 in polluted areas (5.2%) and one in nonpolluted area (1.6%). Some ventilation function impairment and lung infections were noted.

50414

Tsuji, Yoshito

STUDIES ON THE TOXICITY OF FLUORIDE UNDER SOME ENVIRONMENTAL POLLUTIONS. (Fukkabutsu ni yoru chiiki osen to seitai). Text in Japanese. Kogai to Taisaku (J. Pollution Control), 9(4):324-330, April 1973. 62 refs.

The relationship between fluoride and teeth, such as cases of mottled teeth, prevention of decay, and bone formation are discussed. Normally, mottled teeth are formed as a result of consumption of water containing 0.3-0.8 ppm F. However, air pollution containing F has produced some mottled teeth cases in the Kita area of Fukushima prefecture, where the Showa Electric Aluminum Plant is located. When F is taken into the body over a long period of time, the bone structure changes as well as the teeth, and fluorosis occurs. The amount of fluoride causing osteosclerosis or osteoporosis is about 5.9 ppm 11.78 ppm. A large quantity of F interferes with the normal growth of children, whereas a small amount seems to enhance the growth. Children with third degree mottled teeth were small, but those with first degree were rather tall. In the Kita area, the atmospheric F content is 3-5 ppm within 2 km of the Showa Aluminum Plant, and F in the settling particles is 100-230 kg/sq km/mo. The control area 4-7 km from the pollution source has about 1/10th the F content in both atmosphere and settling particles. The average height of the children was slightly greater in the polluted area, and the growth rate per year was also greater in the same area. However, an X-ray examination of the right arm revealed that there was a slight delay of maturity of bones in the fifth and sixth graders. Among the junior high school pupils, the maturity of hand bones was slightly faster among the children from polluted areas.

50419

Fukabori, Sumie, Osamu Tada, and Kenji Nakaaki

THE NORMAL URINE EXCRETION OF LEAD, CADMIUM, MERCURY, AND FLUORIDE. (Ippan kenkojin no nyochu-en, kadominmu, suigin, fusso no haisetsu ni tsuite). Text in Japanese. Japan Society of Industrial Hygiene, p. 188-189, 1973. (Presented at the Japan Society of Industrial Hygiene, Annual Meeting, 46th, April 1973, Paper 305.)

Urine from 400 healthy residents in the metropolitan Tokyo area was analyzed for content of lead, cadmium, mercury, and fluorine. The Pb content was compared to that in urine from occupational workers exposed to an atmosphere containing different concentrations of Pb. The urine of healthy persons contained 6.94 + or - 4.18 micrograms Pb/l, 0.82 + or - 0.62 micrograms/Cd/l, 10.37 + or - 8.21 micrograms Hg/l and 0.50 + or - 0.29 micrograms F/l. The Pb content in urine from workers exposed to 0.01-0.03 mg/Pb/cu m was 14-17 micrograms/l, from those exposed to 0.05-0.10 mg Pb/cu m was 30-60 micrograms/cu m, and from those exposed to 0.17-1.67 mg/cu m of lead was 75-95 micrograms/cu m.

50916

Japan Environmental Agency

POLLUTION DAMAGES TO HUMAN HEALTH AND COUNTERMEASURES. In: Quality of the Environment in Japan. 1972, Chapt. 3, p. 105-113.

The effects of air pollution on human health are reviewed. The most frequent diseases associated with air pollution are chronic bronchitis, bronchial asthma, asthmic bronchitis, and pulmonary edema. The occurrence of these diseases is associated with sulfuric acid mist and suspended dust particles. Nitrogen oxides, carbon monoxide, and photochemical smog are also associated with respiratory diseases. The toxicity of lead, fluorides, mercury, cadmium, and polychlorinated biphenyls was also discussed.

51473

Paluch, J. and I. Szalonek

POLLUTION ON THE AIR BY FLUORINE COMPOUNDS. (Zanieczyszczenie powietrza zwiazkami fluoru). Air Conserv. (English translation from Polish of: Ochrona Powietrza), 4(5):1-11, 1970. 6 refs. (Presented at the French-Polish Symposium on Air Pollution Control, Paris, France, Nov. 17-21, 1969.) NTIS: TT 70-P55124/5

The contribution of fluorine compounds to the general problem of air pollution and the physiological effect of fluorine pollutants on vegetation, man, and animals are examined. The outward symptoms of fluorine poisoning in plants are generally a typical necrosis of the tips and edges of leaves and eventual destruction of the assimilating apparatus, depending on intensity of exposure. The toxicology of the fluorine ion with respect to human beings and animals is connected primarily with changes in the body disposition of calcium and iodine. The external disease symptoms in animals include thickening and formation of nodes on long leg bones, ribs, and joints, leading to lameness; lack of appetite; stiffness. The human organism is more susceptible to fluorine poisoning than animal organisms; the toxic effects in humans are manifested as fluorosis. Emission sources and types of exposure are examined.

52029

Suzuki, Takeo

ENVIRONMENTAL HEALTH. (Kankyo Hoken). Text in Japanese. Koshu Eisei Joho (Public Health Inform.), 3(5):27-35, May 1973. 2 refs.

The recent environmental problems, problems presently increasing in importance, the effects of environment on the human being, and WHO s environmental health projects are discussed. One of the increasing problems is the traceable amount of heavy metal in suspended particulates its relationship with cancer and high blood pressure. The metals which in excessive quantities cause cancer include iron, copper, manganese, magnesium, molybdenum, and zinc; traceable metal carcinogens are nickel, cadmium, and chromium. Those that are conjectured to be carcinogens but have not been proven are cobalt and lead; the role of selenium as a carcinogen is still unclear. The known traceable metals which have bad effects on cardiac and vascular functions are manganese, chromium, vanadium, cobalt, zinc, fluorine, selenium silicon, copper, cadmium, and arsenic. According to the recommendations of WHO, new criteria must be set for nitrogen oxides, polychlorinated biphenyls, nitrite, nitrate, nitrosoamine, manganese, noise, ultrasonic waves, tritium, krypton, and a few other compounds.

52147

Plotko, E. G., V. A. Kostyuchenko, and E. N. Panycheva

TOXICITY OF WEAKLY SOLUBLE FLUORIDES INTRODUCED BY INHALATION ROUTE. (K voprosu o toksichnosti plokho rastvorimykh ftoridov pri ingalyatsionnom vozdeystvii). Text in Russian. Gigiena i Sanit., no. 4:14-16, 1973. 2 refs.

The chronic toxicity of the weakly soluble fluoride cryolite was studied in albino rats that inhaled 3.1 and 0.5 mg/cu m concentrations of this substance for 6 hr a day over 5 months. Concentrations of 3 and 1 mg/cu m produced both general and specific toxic effects on the organism, with manifestations such as disturbances in motor chronaxy, tendency of decreased blood cholinesterase activity, reduced vitamin C level in the adrenal glands, inhibition of carbohydrate metabolism, increased fluorine concentration in the urine, accumulation of fluorine in teeth and bones, edema of the mucous membranes of the respiratory tract, eosinophilic leukocyte infiltration of the lung tissue with focal hemorrhages, granular distrophy of the liver and kidney cells, inflammation of the gastrointestinal tract, and corrugation of brain cells. Cryolite at a concentration of 0.5 mg/cu m was ineffective, and this level may be recommended as the maximum permissible concentration of weakly soluble fluorides in the air of industrial premises.

52557

Byczkowski, S., J. Krechniak, and T. Gietazyn

AN ATTEMPT TO EVALUATE EXPOSURE TO FLUORIDES BASED UPON FLUORIDE LEVELS IN HAIR. Fluoride, 4(2):98-100, April 1971.

The relationship between fluoride exposure and fluoride levels in hair was investigated using three groups of subjects. Group one constituted the control group and were residents of an area with no exposure to fluoride. Group two were residents in an area where the drinking water contained 1.2 mg F/l. Group three consisted of welders with occupational exposure to fluorides. Based on tests of all three groups, a direct relationship between the fluoride levels in hair and their concentration in air and drinking water was determined.

52638

McFee, Donald Ray

ADSORPTIVE CHARACTERISTICS OF DUSTS AND FUMES -- THEIR POSSIBLE ROLES IN TISSUE REACTIONS. Cincinnati Univ., Ohio, Inst. of Industrial Health, Thesis (Ph.D.), Ann Arbor, Mich., Univ. Microfilms, Inc., 1962, 93p. 55 refs.

The role of adsorptive properties in the interactions of particles with tissues and the causation of fibrotic processes was investigated with respect to the adsorptive characteristics of dusts and fumes. Globulins in varying concentrations were subjected to adsorption upon a series of dusts. The value of a constant was determined as an index of strength of the adsorptive bonds for 14 different dusts, including forms of silica (quartz, cristobalite, and silica gel), charcoal, graphite, kaolin, emery, Georgia clay, asbestos, beryllium oxide, ferric oxide, calcium fluoride, and mixtures of dusts and fumes collected from an electrometallurgical plant. The dusts known to be less active in eliciting the production of fibrous tissue were at either end of the spectrum, i.e., had either very weak or very strong bonds. Those known to be active in fibrotic processes were in the middle. The selectivity of the adsorptive sites for certain properties was also investigated. All dusts adsorbed selectively certain groups of proteins, but the differences were not correlated with the biological activity. (Author summary modified)

52686

Balazova, G.

URINARY FLUORIDE ELIMINATION AND FLUORINE DEPOSITION IN BONES AND TEETH OF THE RATS AFTER INHALATION. Fluoride, 6(3):151-154, July 1973.

Urinary fluoride elimination and fluoride deposition in bones and teeth of rats after inhalation was studied. Rats in the experiment inhaled fluoride in concentrations of 9.4-11.7 micrograms/l of air for a period of 5 mo. The animals were divided into four groups, three exposed and one control. The first group was exposed 90 hr, the second 180 hr, and the third 270 hr to hydrogen fluoride in the inhalation chamber. After inhalation, rapid absorption of fluoride in the organism took place. This was indicated by increased elimination of fluorides in the urine, the occurrence of characteristic changes in the dental enamel, and elevation of fluoride in bones and teeth, without radiographic changes. The changes following inhalation are the same as those for oral administration. Fluoride absorbed by the lung was eliminated rapidly from the organism; the amount present in the urine depended upon the duration of the exposure. About 1/3 of the inhaled fluoride was eliminated in the urine. Fluoride deposition in bones and teeth increased regardless of the duration of intoxication. No increase in fragility of the bones was noted in relation to their fluoride content. (Author abstract)

52764

Prival, Michael J. and Farley Fisher

FLUORIDES IN THE AIR. Environment, 15(3):25-32, April 1973. 61 refs.

Fluoride is released into the air in large quantities by aluminum reduction plants, phosphate processors, steel mills, coal burning operations, brick and tile manufacturers, and various less significant sources. It can cause adverse effects when ingested by domestic animals or absorbed by plants. Fluoride air pollution can adversely effect human health. Fluorides are released into air in both a gaseous state as hydrogen fluoride and silicon tetrafluoride and in solid particles. Nationwide control of airborne fluorides is needed. The simultaneous control of levels of fluoride in the air and levels in sensitive plants, in food, and in forage should all be included in any set of standards. Permissible concentrations should be determined by field studies in areas where fluoride pollution is a problem. Improvement in occupational health standards for hydrogen fluoride and other airborne fluorides is needed. Any devices used to control emissions of fluoride from polluting industries can, and should, be designed to minimize exposure of the people who work within industry. Monitoring of fluorides is mentioned.

54302

Hackel, R. and J. Reichert

ON THE DEMONSTRATION OF SILICOFLUORIDE POISONINGS. (Zum Nachweis von Silicofluoride-Vergiftungen). Beitr. Gerichtl. Med., vol. 29:421-424, 1972. 4 refs. Translated from German, 7p.

Silicofluoride poisoning was chemically demonstrated by analyzing body organs containing lethal doses of zinc fluate (ZnSiF6) for zinc. The Zn content was determined by measurement of atomic absorption after destruction of the organic material and this concentration was significantly higher than normal standards. The zinc silicofluoride intoxication was easily diagnosed in connection with the positive fluoride analysis of the stomach. Normal values for mg of Zn/100 g in blood are 0.880, in liver 5.717, and in kidneys 4.225. In the case of zinc silicofluoride poisoning, the values were 76.659 for blood, 10.575 for liver, and 11.075 for kidneys. Fluoride and silicofluoride vales were calculated from the Zn values and are expressed in mg/100 g. In Blood, the values for Zn are 76.659, for fluoride 133.675, and for ZnFiF6 243.270. In urine the values are 0.375, 0.769, 1.190; in the stomach the values are 274.325, 478.359, 870.546; in liver the values are 10.575, 18.440, 33.559; in kidneys the values are 11.075, 19.312, 35.146. The determination of the metallic cation is an effective chemical demonstration of silicofluoride poisoning.

54968

Obe, Gunter and Renate Slacik-Erben

SUPPRESSIVE ACTIVITY BY FLUORIDE ON THE INDUCTION OF CHROMOSOME ABERRATIONS IN HUMAN CELLS WITH ALKYLATING AGENTS IN VITRO. Mutat. Res., 19(3):369-371, Sept. 1973. 11 refs.

Sodium fluoride was investigated in combination with three alkalating agents in human cells in vitro to determine if fluoride inhibits the induction of chromosome breaks. The mutagens used were 2,5-bis-(methoxyethoxy)-3,6-bis-ethyleneimino-p-benzoquinone (Al39), 2,3,5-tris-ethyleneimino-p-benzoquinone (trenimon), and 2,3,5,6-tetraethyleneimino-p-benzoquinone (TEB). Sodium fluoride alone had no effect on the chromosomes. The ethyleneimines induced typical chromatid aberrations whose frequencies were lowered in the combination series with NaF. The suppressive effect of fluoride was especially clearcut with the chromatid translocations (RB prime). Considerable amounts of triradials were only seen with TEB. This aberration type was also lessened in the combination series, showing a frequency of 0.04 per cell with TEB alone and 0.01 with TEB and NaF. The frequencies of achromatic lesions were lowered or not changed at all in the combination series. Fluoride had a strong antimutagenic effect on the aberration induction with polyfunctional alkylating agents.

55517

Schorn, Gert

MANKIND THREATENED BY SLOW DEATH. (Wir leben mit dem schleichenden Tod). Text in German. Deut. Apoth.-Z., 111(2):46-49, Jan. 1971.

Global problems of environmental pollution are outlined, and criticism is given of the ignorance and one-sided profit-mindedness displayed in environmental issues. The steady increase in the atmospheric carbon dioxide concentration, a result of ever-increasing energy demands, high carbon monoxide and sulfur dioxide levels, occurring especially in urban agglomerations with heavy traffic and in industrial areas, as well as the ubiquitous presence of lead and fluorine in the atmosphere are among the serious environmental hazards. Health, plant, and material damages due to CO, SO2, and nitrogen oxides are described. The hazards of lead residue are in its ability to accumulate in the human organism and to pass the placental barrier. Lead is activated during pregnancy, and it interfered with the synthesis of desoxyribonucleic acid, sexual functions, and spermiogenesis. Adequate technical solutions are now available for the control of vehicle exhaust CO emissions.

56538

Waldbott, G. L. and S. Steinegger

NEW OBSERVATIONS ON CHIZZOLA MACULAE. Proc. Int. Clean Air Congr., 3rd, Duesseldorf, West Germany, 1973, p. A63-A67. 12 refs.

Epidemiological findings are reviewed for four groups of individuals from widely separated geographical areas where outbreaks of skin lesions (maculae) occurred. Fluoride exposure either by industrial air pollution or by presence in the drinking water or vegetation was common to all outbreak areas. The skin lesions are round or oval maculae of one to two cm in diameter and not sharply delineated. They are painless upon digital pressure and remain unchanged upon diascopy. Color upon first appearance is pinkish-brown which turns to a darker red brown after five to seven days before gradual fading. There is no break of the skin, nor are the lesions raised above the surface. The limbs and to a lesser extent the trunk are the parts mainly affected. Histological specimens have shown mild pericapillary infiltrations with lymphocytes, neutrophiles, and mast cells involving the upper layer of the chorium. Laboratory studies showed eight of 22 cases exhibiting an elevation of alkaline phosphatase. Attempts to reproduce the lesions experimentally in mice and rats have failed thus far, and this fact combined with a higher incidence of lesions among children and women suggests that certain factors in addition to fluoride intake are involved.

56931

Tsunoda, H.

EXPERIMENTAL EXPOSURE OF GOATS TO ENVIRONMENTAL POLLUTION BY FLUORIDES IN THE AIR, PART I: OUTLINE OF THE EXPERIMENT. (Taiki chu fukkabutsu no kankyo osen ni yoru yagi no bakuro jikken -dai 1op- jikken

galyo). Text in Japanese. Taiki Osen Kenkyu (J. Japan. Soc. Air Pollution), 8(3):418, Oct. 1973. (Presented at the Japan. Society for Air Pollution, Annual Meeting, Fukushima, Japan, 14th, Nov. 6-8, 1973.)

Goats are bred in fluorine-polluted fields to determine the effects of air and environmental pollution. Experimental goats were bred in fields 0.1 km and 0.5 km away from an aluminum refinery. The average concentrations of hydrogen fluoride in the air were 0.9-2.6 ppm and 0.5-0.6 ppb. The goats are fed 21.8-42.6 ppm F2 in dried herbs and 3-7 ppm F2 in bran and potatoes. Control goats are pastured 4-6 km from the factory in a non-polluted area and fed 5-9.9 ppm F2. Monthly analysis shows F2 contents in the blood 4-6 times greater in the experimental goats, and 5-7 times greater in the urine. The F2 in the feed is more influential than the F2 in the air.

56933

Takizawa, Y.

ON THE INFLUENCES OF FLUORIDES ON HUMAN BODY. (Fukkabutsu no jintai ni oyobosu eikyo ni tsuite). Text in Japanese. Taiki Osen Kenkyu (J. Japan. Soc. Air Pollution), 8(3):421, Oct. 1973. (Presented at the Japan. Society for Air Pollution, Annual Meeting, 14th, Fukushima, Japan, Nov. 6-8, 1973.)

An epidemiological investigation was conducted on the total population residing within 1 km of an aluminum refinery. Fluorine content in the urine, subjective symptoms, percussion, stethoscopy, dental health, respiratory function, hematology, alkaline phosphatase, basal metabolism, ECG, chest and bone x-rays, and urinalysis were considered. The investigations on persons older than 40 and children between 3 and 15 show the following: fluoride ion concentration was higher in the polluted area for both age groups, macular teeth appeared 2 times as frequently in the polluted area, the frequency of caries in permanent teeth was 69% in the polluted areas, anomalies of bone development in children were more frequent in the polluted areas, respiratory complaints were more frequent in the polluted areas and chronic bronchitis morbidity was high, diffuse shadows on the lungs were found in the polluted areas, and deposition of Al was less than 10 micron in all respiratory systems.

56934

Sato, Y., H. Tsunoda, and N. Konno

EXPERIMENTAL EXPOSURE OF GOATS TO ENVIRONMENTAL POLLUTION BY FLUORIDES IN THE AIR, PART III: ON THE TRANSPLACENTAL PASSAGE OF FLUORIDES. (Taikichu fukkabutsu no kankyo osen ni yoru yagi no bakuro hikken -dau 3po- fukkabutsu no taiban tsuka ni tsuite). Text in Japanese. Taiki Osen Kenkyu (J. Japan. Soc. Air Pollution), 8(3):420, Oct. 1973. (Presented at the Japan. Society for Air Pollution, Annual Meeting, 14th, Fukushima, Japan, Nov. 6-8, 1973.)

The fluorine content of the blood of a mother goat bred in fluoride-polluted air was determined and compared to the F2 levels in the hard and soft tissues of her kids directly after birth. The F2 levels in the serum of one mother goat fluctuated widely between 0.05-0.6 ppm in a year, but the other experimental goat had a more stable level of 0.05-0.15 ppm. The average F2 content was higher before, rather than during, pregnancy. The distribution of F2 in the kids concentrated in the aorta and the spleen from the soft tissues, and in the ribs, vertebrae, and bones (excluding teeth), from the hard tissues. A correlation between the F2 contents of the mother s serum and the F2 contents in the kid s body, especially in the hard tissues, was recognized.

56959

Kimura, I., H. Shioi, T. Suda, Y. Kawarada, Y. Sato, N. Konno, S. Sakurai, and H. Tsunoda

EXPERIMENTAL EXPOSURE OF GOATS TO ENVIRONMENTAL POLLUTION BY FLUORIDES IN THE AIR, PART II: RESULTS OF CLINICAL EXAMINATIONS FOR ONE YEAR. (Taiki chu fukkabutsu no kankyo osen ni yoru yagi no bakuro jikken -dai 2ho- ichinenkan no rinsho kensa seiseki). Text in Japanese. Taiki Osen Kenkyu (J. Japan. Soc. Air Pollution), 8(3):419, Oct. 1973. (Presented at the Japan. Society for Air Pollution, Annual Meeting, 14th, Fukushima, Japan, Nov. 6-8, 1973.)

A comparison of the rate of weight increase and blood chemistry in goats bred in fluorine-polluted and control areas is given. No difference of the rate of body weight increase, nor any difference in tissue appearance or palpitation is noted. Hematocrit percentage, hemoglobin, total protein, albumin, glucose, bilirubin, TTT, ZTT, GOT, GTP, Alkaline-phosphatase, LDH, LAP, cholesterol, BUN, nutrition, liver function, and enzyme activity were similar for the experimental and control goats for the first year.

57024

Ronzani, E.

ON THE EFFECT OF INHALATIONS OF IRRITANT INDUSTRIAL GASES ON THE PROTECTIVE ABILITIES OF THE SYSTEM WITH RESPECT TO INFECTIOUS DISEASES. (Ueber den Einfluss der Einatmugen von reizenden Gasen der Industrien auf die Schutzkrafte des Organismus gegenueber den infektiven Krankheiten). Arch. Hyg. Bakteriol. (Munich), vol. 70:217-233, 1909. Translated from German, 20p.

Rabbits, guinea pigs and doves were exposed to hydrofluoric acid gas for extended periods of time at concentrations of 0.01%, following preliminary examinations at higher levels with other animals of the same kind, in order to examine the overall effects of the gas as well as the effects of its inhalation on immunological mechanisms. Autopsies, histological examinations, and serum tests were performed subsequent to exposure. The extended inhalations were found to cause death in a significant number of animals with symptoms of catarrhal bronchopneumonitis, interstitial pneumonitis, and marasmus. Animals which survived experienced severe lesions of the lungs, severe anemia, and weight loss up to 23.2%. Experimental animals also produced considerably less agglutinating substances than control animals; and among animals immunized for typhus, those exposed to inhalations showed a sharp decrease in the production of specific antibodies. Bacteriocidal studies using B. prodigiosi showed considerable weakening of the lungs capability to destroy such microorganisms in the face of Hf inhalation.

57299

Juerging, Peter

PICHENS AS BIOINDICATORS OF AIR POLLUTION? (Flechten - Bioindikatoren der Luftverunreinigung)? Text in German. Society for Ecology, Proc. Conf. Load Loadability Ecosystems, Giessen, West Germany, 1972, p. 141-145. 2 refs.

The effects of sulfur dioxide, hydrochloric acid, hydrofluoric acid, carbon monoxide, and ammonia on Hypogymnia physodes, Parmelia sulcata, P. caperata, P. scortea, and Xanthoria parietina were studied in open-air fumigation tests in Munich. Gas- and species-specific color changes of all species were observed during the fumigation tests. The species that were not watered showed no damage. Compared with Hypogymnia physodes, Parmelia sulcata and P. scortea featured relatively high resistance against ammonia, CO, SO2,

and HF. Hydrochloric acid exerted the strongest and most uniform effect on all species. Transplanted lichen species exposed to an SO2 concentration of 0.1 mg/cu m in winter in Munich showed partial damage, while a lower SO2 concentration of 0.05 mg/cu m in summer was harmless for all species.

57701

Nishimura, H.

TETATOGENIC SUBSTANCES. Intern. Chem. Eng., 13(4):774-780, Oct. 1973. (Also: Iden (Heredity), 26(5):19-22, 1972.)

The toxic effects of various substances on human beings are discussed. Fetuses are highly susceptible to toxic and mutagenic effects from external causes. The origin, nature, and detection of disturbances in fetuses are mentioned. Several cities with high air pollutant concentrations had higher infant death rates and higher rates of deformed infants and stillbirths. Poisonous heavy metal and inorganic compounds include mercury, lead, sodium selenite, fluorine, and arsenic. Pesticides such as DDT and PCB (polychlorinated biphenyls) also have harmful effects. Mercury and PCB have contaminated rice, fish, and shellfish, foods which mainly constitute the diet of Japanese. Miscellaneous organic compounds such as PCB, detergents, and organic solvents have also affected infants and fetuses. Artificial sweeteners such as cyclamates and sodium glutamate affected laboratory animals.

59073

Shugaev, V. A. and V. A. Belyaev

SKIN-RESORPTIVE EFFECT OF HYDROGEN FLUORIDE FUMES. (Kozhno-rezorbtivnoye deistvie parov ftoristogo vodoroda). Text in Russian. Gigiena Truda i Prof. Zabolevaniya, no. 1:31-33, 1974. 9 refs.

The repeat action of hydrogen fluoride in concentrations of 38.6 an/ 72 mg/cu m on the respiratory organs and skin of rats caused marked resorptive effects in both cases. Fluorine accumulated in the organism, and specific biochemical changes occurred in the carbohydrate, mineral metabolism, and the redox processes. The degree and nature of pathological alterations were similar in an isolated action of gaseous HF both via the skin and the organs of respiration. Possible penetration of fluorine into the organism in ionic form via the skin occurred.

60228

Tsuji, Yoshito

AIR POLLUTION AND HUMAN HEALTH. (Taiki osen to kenko). Text in Japanese. Fukushima Igaku Zasshi (Fukushima Med. J.), 22(5-6):159- 160, Dec. 1973. (Presented at the Fukushima Medical Association, Annual Meeting, 94th, Nov. 11, 1973.)

Influences of air pollution on the human body generally appear as epidemiological increases of non-specific disturbances of pulmonary functions resulting from interactions between the pollutant, the environment, and the host. Initial effects are eye and respiratory system irritations, followed by increases in airway resistance and mucus secretion, and they end in acute and chronic diseases such as bronchitis and emphysema. Air pollution increases discomfort experienced in chronic diseases. The known effects of specific pollutants are described, with special attention given to suspended dusts and fluorine compounds.

60625

INDIVIDUAL COMPONENTS OF AIR POLLUTION. (Die einzelnen Komponenten der Luftverunreinigung). Text in German. Bull. Eidgenoess. Gesundheitsamtes, Beilage B, no. 6:324-343, Dec. 1973.

The individual components of air pollution, such as sulfur dioxide, particulate matter, 3,4-benzo(a)pyrene, lead, fluorine compounds, carbon monoxide, and smog, as well as their effects on the human and organisms and on plants are described. The increase of the total SO2 emission between 1960 and 1970 were relatively moderate despite the strong increase in the fuel consumption, while an increase by about 40% until 1980 is expected unless adequate measures such as (fuel and flue gas desulfurization) are introduced. Domestic heating-generated SO2 is especially remarkable due to the low chimneys. Particulate matter, especially respirable dust and soot, are hazardous because they can penetrate to the lower respiratory tract, and may contain other pollutants, such as SO2. Benzo(a)pyrene concentrations of 2-15 micrograms/1000 cu m were measured in Basel and Zurich. Carbon monoxide, emitted mostly by automobiles, causes no subjective symptoms of poisoning as long as its concentration is below 60 cu cm/cu m, corresponding to COHb values below 10%. The rate of resorption of atmospheric lead is estimated at 30-40%. The lead concentration in Zurich increased from 1.5 microgram/cu m in 1949 to 1.9 micrograms/cu m in 1973. Photochemical smog and fluorine compounds have strong irritative effect on the human organism and on plants.

60748

Grieser, N.

HYDROFLUORIC ACID. (Fluorwasserstoff). In: Medizinisches Institut fuer Lufthygiene und Silikoseforschung Jahresbericht 1971. Text in German. Duesseldorf, Michael Triltsch Verlag, 1972, p. 69-89. 77 refs.

Studies on the mechanism of action, resorption, elimination, and the acute, subacute and chronic effects of hydrofluoric acid in the human and animal organisms are reviewed. Fluorine can enter the human and animal organism enterally, pulmonally, or percutaneously. The resorption after enteral uptake is strongly dependent on the solubility of the fluorine compounds. Very rapid diffusion of fluorine in tissues and body fluids was observed. Chlorine is eliminated from the organism mainly by the kidneys, while residual fluorine is incorporated in bones from which it may again enter the blood. Cumulation of fluorine in soft tissues was not evidenced. Fluorides inhibit numerous enzymatic processes due to the formation of fluorine-containing enzyme antagonists, and through binding the metallic cofactors of the enzymes. Retardation of the proliferation and destruction of bone cells, and gelatin-like degeneration of the bone marrow due to fluorine were observed. Pathologic changes of bones are possible at fluorine concentrations of 3000 to 5900 ppm. Changes in the metabolism in organs and bones, anorexia, cachexia, diarrhea, lesions of the renal tissues, and exostoses may occur in subacute poisoning by fluorine. Acute poisonings are characterized by such symptoms as changes in the enzymatic processes, especially in calcium and glucose metabolism, muscular fibrillation, clonicotonic spasms, hyperpnea, lachrymation, salivation, intensified intestinal tonus, gastroenteritis, and necrosis of the myocardium. The maximum allowable workplace concentration of hydrofluoric acid in West Germany is set at 2 mg/cu m.

61146

Kita, H.

ENVIRONMENTAL POLLUTION AND HEALTH (SPECIAL LECTURE AT THE THIRTY- SEVENTH ANNUAL MEETING OF JAPANESE ASSOCIATION OF PHYSICAL MEDICINE,

BALNEOLOGY AND CLIMATOLOGY). (Dai 37kai Nippon Onsen Kiko Butsuri Igakukai Sokai, Tokubetsu koen; Kankyo osen to kenko). Text in Japanese. Nippon Onsen Kiko Butsuri Igakkai Zasshi, (J. Japan. Assoc. Phys. Med., Balneol. Climatol.), 36(1.2):34-36, Oct. 1972.

The air pollutants sulfur dioxide, nitrogen oxides (mainly nitrogen dioxide), carbon monoxide, lead, hydrogen fluoride, cadmium, vanadium, ozone oxidants, aldehyde, peroxyacetyl nitrates, and smoke are discussed. Better indices of air pollution than SO2, CO, and dust (the currently used indices) are needed. The effects of air pollution on humans, especially the elderly, infants, and the sick, are reviewed. The relationships between environmental pollution and Minamata and Itai-Itai disease are discussed. Bathing in, drinking and inhalation of hot-spring water is suggested as a possibly beneficial practice.

61467

Makino, S. and A. Miyamoto

AIR POLLUTION AND ALLERGY. (Taiki osen to arerugi). Text in Japanese. Jibi Inkoka (Otolaryngol.), 45(10):701-712, Oct. 1973, 36 refs.

The relationship between air pollution and respiratory diseases such as allergies and asthma is reviewed. Epidemiological studies reveal that air pollution tends to induce respiratory symptoms in older persons with allergic dispositions and asthma. Sulfur dioxide and photochemical oxidant levels have been implicated in the onset of asthmatic fits. Other offenders, existing as gases, dusts, and aerosols, include carbon monoxide, sulfur oxides, nitrogen oxides, hydrocarbons, metal powders, pesticides, fluorides, asbestos, radioactive substances, and natural pollutants such as pollen and fungal spores. Experimental animal studies are described. Airway hypersensitivity is discussed in relation to the effect of chemical mediators, allergens, and housedusts. Although air pollution is known to aggravate allergies at the levels of stimulation of airway mucosa, constriction of bronchus, accentuation of airway hypersensitivity, stimulation of antibody production, and increase of airway infection, it is still not known whether it is a causal factor.

61646

Hodge, Harold C. and Frank A. Smith

FLUORIDES. In: Metallic Contaminants and Human Health. D. H. K. Lee (ed.), New York, Academic, 1972, Chapt. 7, p. 163-187. 31 refs.

In an overall review of fluorides, the health hazards and airborne distribution of the compounds are discussed. The literature reports the concentrations of airborne fluoride in individual samples range from traces to maximal values of approximately 8 mg/cu m, averages range from 012 to 3.4 mg/cu m. Urinary fluoride excretions range from 1-5 mg/11. Analyses of the ambient atmospheres normally present over a number of U. S. cities show fluoride concentrations ranging between 0.01 microgram/cu m and 3.9 micrograms/cu m. Fluoride absorption has not been measured, but assuming a volume of 20 cu m is inhaled per 24 hr with 100% retention, the maximal dose would be 0.004-0.04 mg daily. In a heavily polluted area, the intake of the average man would be about 0.04 mg. Such amounts constitute negligible contributions to the total daily intake of fluoride from food and water, about 0.5-1.5 mg.

62177

Oshina, T., R. Sugai, H. Sato, and K. Kaneda

RESULTS OF THE ENVIRONMENTAL POLLUTION INVESTIGATION ON FLUORIDES IN THE SURROUNDING OF AN ALUMINUM REFINERY - INVESTIGATION OF FLUORINE POLLUTION OF DIETS. (Arumi seiren kojo shuhen no fukkabutsu no kankyo osen chosa - seishu shokuhin no osen chosa). Text in Japanese. Nippon Koshu Eisei Zasshi (Japan. J. Public Health), 20(10)Special Suppl.): 1p., Oct. 1973. (Presented at the Japan Society of Public Health, Annual Meeting, 32nd, Hiroshima, Japan, Oct. 1973. Paper 561.)

By the investigation of daily diets of inhabitants of the area surrounding an aluminum refinery, the intake of fluorine was estimated to obtain the fundamental information concerning indirect effects of fluorine to human body. Differences of fluorine in urine between areas, ages, and sexes in the districts where the effects of air pollution of fluorine had been recognized were considered. The aerial content of fluorine in the neighboring zone of the refinery averaged 381 micrograms/LTP sq cm/mo from May 1972 to Feb. 1973. The ingested fluorine in the neighboring zone was 1.57-2.33 times larger than that of the control area, in the surronding zone 1.33-2.13 times larger, and both are significantly larger in adult females and children of both sexes. The fluorine content of urine in the people of the neighboring zone and the surrounding zone of the refinery were respectively, 1.29-1.92 and 1.30-2.13 times larger in the people in the control area. The ratio of fluorine in urine to retained fluorine averaged 0.635 in adults and 0.476 in children, the ratio in adults to the ratio in children being 1:0.75. There is apparently a difference of fluorine metabolism in age.

62596

Balazova, G. and V. Lipkova

EVALUATION OF SOME HEALTH PARAMETERS IN CHILDREN IN THE VICINITY OF AN ALUMINUM FACTORY. Fluoride, 7(2):88-93, April 1974. 4 refs.

The health status of 6-14-year old children was investigated with special regard to the hematological indices and the content of fluorine compounds in urine and hair. The children have been living in a settlement in the environs of the aluminum factory in operation for 20 yr. In the first years of the operation of the factory, examinations of children showed evidence of potential hazard, induced by the influence of the factory on the environment. Certain sanitary measures were designed and implemented: a portion of the population was translocated; precautions were taken regarding consumption of crops grown in the polluted area; and regular visits to clinically suitable recreational areas were organized every year for children. After 10 yr the medical examinations were repeated. The values obtained were related to the concentration of fluorine compounds in the air and compared with the results obtained from a group of children of the same age during the first years of the operation of the factory. There was a clear and total improvement of the studied indices. Their values approach the values of the control group of children from non-exposed areas. (Author summary modified)

64484

Sato, Y. and F. Tsunoda

EFFECTS OF AIRBORNE FLUORIDE ON GOATS, PART I: PLACENTAL TRANSFER OF FLUORIDE. (Taiki chu fukkabutsu no kankyo osen ni yoru yagi no bakuro jikken (dai ippo) fukkabutsu no taiban tsuka ni tsuite). Text in Japanese. Nippon Koshu Eisei Zasshi (Japan. J. Public Health), 21(5):291-295, May 1974. 32 refs.

The placental transfer of fluoride as an environmental pollutant via air was examined on goats bred in the polluted environment surrounding an aluminum refinery in Fukushima

Prefecture. The concentration of hydrogen fluoride in the air at a point 0.5 Km from the refinery averages 0.6-1.4 ppb, and is less than 4 ppb at the highest. The animals were fed with weeds and vegetables grown there as well as with bran in the winter season. The fluoride content in the blood of the mother goats increased proportionately with the fluoride content of the feed. An increase of the fluoride content of the mother goat s blood increased retention of fluorides in the body of newborns, especially in the hard tissues. Airborne fluoride can be transferred via polluted feeds from the mother to her offspring.

66044

Cecilioni, V. A.

FURTHER OBSERVATIONS ON CANCER IN A STEEL CITY. Fluoride, 7(3):153-165, July 1974. 9 refs. (Presented at the Conference of I.S.F.R., 5th, Annual, April 8-11, 1973.)

The incidence of cancer in the steel city of Hamilton (Ontario) was investigated during 1969-1970. The death rate from cancer in Hamilton was higher than in the less industrialized city of Ottawa. The highest rate (65 per 100,000) occurred in the proximity of the steel mills, compared with the death rates (23 and 12 per 100,000) farther distant. Continuous monitoring in the industrial area disclosed that the levels of carbon monoxide, fluoride, lead, nitrogen oxides, sulfur dioxide, and suspended particulates increased to 15 times above the average of the province of Ontario. In 1971-1972 the atmospheric fluoride levels were up to 20 times higher than the average value for Ontario as a whole which is 40 mgm F/100 sq cm/30 days. Admission records at two large Hamilton Hospitals showed a close correlation between respiratory disease and the daily pollution index. (Author abstract modified)

66668

Davydova, V. I. and Y. N. Pochashev

ON THE JOINT ACTION OF COMPOUNDS OF MANGANESE AND FLUORINE ON THE BODY. (K voprosu o kombinirovannom deystvii na organizm soyedineniy margantsa i ftora). Text in Russian. Gigiena i Sanit., no. 7:21-25, 1974. 6 refs.

The joint action of low concentrations of manganese dioxide and hydrofluoric acid in the air, a combination usually occurring during welding operations, was studied in albino rats and compared with the action of the individual components. The respective concentrations corresponded to the maximum allowable values or were 50% lower; 0.28 and 0.16 mg/cu m for MnO2, and 0.56 and 0.22 mg/cu m for HF. The animals were exposed for 2.5 to 3 hrs daily for 16 weeks. The joint action of MnO2 and HF on the animal organism was different from that of the individual compounds and potentiation as well as attenuation of the effects of the individual compounds were observed. Statistically significant differences from groups exposed to either MnO2 or HF were observed in such changes as increase of the relative weight of the lung, increased stain retention by spleen and adrenal tissues, reduction of the serum alkaline phosphatase activity, increase in the serum SH group level, and prolongation of the chronaxia. Also, premature damage of the dental enamel was observed. The maximum allowable MnO2 and HF concentrations in their joint action should be set at a level close to their respective MAC values, i.e., 0.15 mg/cu m for MnO2, and 0.25 mg/cu m for HF.

67325

Marier, J. R. and Dyson Rose

ENVIRONMENTAL FLUORIDE. National Research Council of Canada, Ottawa (Canada), Pub-12,226, 1971 (?), 39p. 168 refs.

A review is presented on fluoride contamination of the environment. Topics covered include: the occurrence of fluoride in the soil, water, air, vegetation, terrestrial mammals, wildlife, ocean water, seafood, and man; sources and sinks of fluoride pollution; fluoride contamination of vegetation; the effects of fluoride on animals; and the effects of fluoride on man, including sources and doses, analysis and diagnosis, toxic effects, and intaky of highly toxic organofluorides. Airborne fluoride is of two types, gaseous and particulate, each of which can contain components differing in solubility. Fluoride released as particulate matter tends to deposit as fallout in the general downwind vicinity of fluoride emitting source. Depending on the type of industrial operation, a factory-stack effluent is estimated to contain from 3.6-15,600 mg/Fl, with the gaseous phase representing anywhere from 0.7-96%. Skeletal fluorosis is the most common toxic effect of fluoride exposure, though other disorders such as anemia and symptoms involving the skin, eyes, gastrointestinal tract, and nervous system are also reported.

67440

Miessner, H.

DAMAGES TO ANIMALS BY INDUSTRIAL EMISSIONS. (Schaedigung der Tierwelt durch Industrie und Technik). Text in German. Deut. Tieraerztl. Wochenschr., 39(22):340-345, May 1931. 25 refs.

Damages and health hazards due to air pollutant emissions and other environmental pollutants in connection with industrial activity are surveyed. Sulfur dioxide, arsenic trioxide, and lead, emitted by ore smelters, can cause damage to plants and animals either directly or by ingestion of contaminated plants. Sulfur dioxide causes reduction of the magnesium, phosphoric acid, and calcium levels in plants, and osteomalacia due to depletion of the calcium reserves in animals. Arsenic is responsible for colic, emesis, fatty generation in the liver, cachexia, eczema, and overall asthenia in cattle. Lead, accumulating in the liver, bones, kidneys, spinal cord, intestines, and muscles, causes gastric troubles and convulsions in acute poisoning, and general depression, abortion, colic, muscular pains, epilepsy, and pareses in chronic poisoning. Fluorine compounds, and especially hydrofluoric acid, as emitted by fertilizer plants, affect the bones due to the mobilization and depletion of calcium.

68520

Sakurai, S., F. Tsunoda, S. Ishikawa, S. Nakaya, and Y. Suzuki

STUDIES ON AIR POLLUTION BY FLUORIDE. PART XII: THE NORMAL VALUE OF FLUORIDE CONCENTRATION IN SERUM. (Fukkabutsu ni yoru taiki osen ni kansuru kenkyu (dai 12 ho) kessekichu fusso nodo no tsujochi ni tsuite). Text in Japanese. Nippon Koshu Eisei Zasshi (Japan. J. Public Health), 21(10:323, Oct. 1974. (Presented at the Japanese Society of Public Health Annual Meeting, 33rd, Fukushima, Japan, Oct. 16-18, 1974, Paper 437.)

The fluorine concentration in serum was studied as an index for biological load of fluorides. Trace concentrations of fluorine in the sera of the population in a non-polluted area appeared in 55% of the men and 77% of the women; 99% of the values were less than 0.02 ppm fluorine. The frequency of people with more than 0.05 ppm of fluorine was a little higher in the mountainous parts of the non-polluted area. There were no cases of persons with a serum fluorine concentration of more than 0.05 ppm near the aluminum refinery in a polluted area which had an aerial fluorine concentration of around 1 ppb; however, 25% of the rural persons near the refinery showed serum fluorine concentrations of more than 0.05 ppm.

68551

Illinois Inst. for Environmental Quality, Chicago, Ill., Environmental Health Resource Center

HEALTH EFFECTS AND RECOMMENDATIONS FOR AIRBORNE FLUORIDES (FINAL REPORT). Proj. 10.006, Rept. IIEQ 74-23, 65p., June 1973. 99 refs. NTIS: PB 233845

Airborne fluorides are injurious to corn, sorghum, tomatoes, soybeans, gladioli, and a variety of other plants. The human health effects of exposure to excessive concentrations of airborne fluorides include acute effects such as severe eye and nose irritation and skin injury, and chronic effects such as osteosclerosis. Based on these two considerations, phytotoxicity and human toxicity, the Environmental Health Resource Center supports a standard for airborne fluorides of 0.7 micrograms/cu m based on a 24-hour average. This standard applies to airborne fluorides in both gaseous and particulate forms and is based on one atmosphere of pressure and 25 C. The chronic and acute effects of fluorides upon which this recommendation is based are reviewed. (Author abstract modified)

68583

Tiunov, L. A. and V. V. Kustov

COMBINED BIOLOGICAL ACTION OF CHEMICAL COMPOUNDS AND PHYSICAL FACTORS OF THE ENVIRONMENT. (Kombinirovannoye biologicheskoye deystviye khimicheskikh soyedineniy, khimicheskikh i fizicheskikh faktorov vneshney sredy). Text in Russian. Zh. Vses. Khim. Obshchestva, Im DI Mendeleeva, 19(2):164-169, 1974. 84 refs.

Studies on the combined action of chemical compounds and physical factors of the environment on the organism are reviewed. Summation, potentiation, antagonism, or independent action may occur during the simultaneous action of different toxic and irritating substances, including air pollutants. The simultaneous presence in the atmosphere of nitrogen dioxide, ozone, and unsaturated hydrocarbons results in the formation of highly irritative peroxides, epoxides, and aldehydes, while NO2 forms practically harmless ammonium nitrate with ammonia. Extraneous substances present in the organism may increase or decrease the toxicity of other extraneous substances by inhibiting or activating enzymes responsible for the metabolism of the latter. Carbon monoxide and carbon tetrachloride inhibit the microsomal enzymes. Accelerated development of poisoning, and increased susceptibility of the organism to toxic substances were observed at high temperatures. High humidity increases the irritative effect of nitrogen oxides and hydrogen sulfide and the toxicity of fluorine compounds and certain petroleum products while alleviating the course of poisoning by gasoline. The effect of CO and carbon tetrachloride is intensified by strong muscular stress. The development of hypoxia due to CO, carbon tetrachloride, benzene, and gasoline is facilitated by reduced barometric pressure. Loud noise intensifies the effect of CO, boric acid aerosol, and cracking gas, while vibration potentiated the effect of fluorine, lead, cobalt dust, and quartz dust. Hypoxia-inducing substances, such as CO and sodium nitrite antagonize ionizing radiation.

70519

Balabajewa, L.

THE FLUORINE IN BONES AND TEETH OF RABBITS WHICH WERE EXPOSED UNDER NATURAL CONDITIONS. (Der Fluorgehalt in Knochen und Zaehnen von Kaninchen, die unter natuerlichen Bedingungen exponiert wurden). Text in German. Z. Ges. Hyg. Ihre Grenzgebiete (Berlin), 20(9):591-592, 1974. 11 refs.

In Dimitroffgrad, Bulgaria 1500 m from a fluorine emitting chemical combine, 15 rabbits were exposed to the fluorine polluted air for determination of the influence on the fluorine content in bones and teeth. For determination of fluorine in biological material, a modified ion exchange method by Nilsen was used. An aluminum eriochrome zyanine complex was photometrically determined by the method of Kateswarlu. For elimination of possible errors, the fluorine content was calculated in relation to the mineralized ash residue rather than to the mass of dry substance. The results show a clearly higher fluorine content in those rabbits exposed to fluorine polluted air. The measured concentrations were 96.7 mg% F in the bones of the exposed animals vs. 75.2 mg% F in the bones of the control group. In teeth the measured concentrations were 242.1 and 209.2 mg% F. Since the fluorine content in drinking water in Dimitroffgrad is negligible, the higher F concentrations are clearly attributable to atmospheric pollution from the chemical combine.

71324

Nakaya, S., S. Sakurai, Y. Suzuki, K. Itai, and F. Tsunoda

ON THE QUANTITATIVE DETERMINATION OF FLUORINE IN URINE BY ION ELECTRODE. (Ion denkyoku ni yoru nyochu fusso teiryoho ni tsuite). Text in Japanese. Sangyo Igaku (Jap. J. Ind. Health), 16(4):498, Sept. 1974. (Presented at the Tohoku Lecture Meeting, 32nd, Yamagata, Japan, July 20, 1974.)

The fluorine content of urine collected over a 24-hour period can be used as a biological indicator of exposure to fluorine compounds in the air. Several conditions of pre-treatment and preservation of the urine specimen were examined. The stability of 10 ml aliquots kept in closely stoppered vials was better than the 2000 ml sample kept in a stoppered bottle, considering time and temperature. One hundred percent fluorine was shown after 3 weeks. The standard deviation after keeping for 3 weeks at 0 C and 24 C was very small compared to 40 C. Fluorine contents were quantified by the ion-electrode method.

71484

Ueda, K.

STUDIES AND COUNTERMEASURES FOR DISEASES DUE TO ENVIRONMENTAL POLLUTION. (Kogaibyo no kenkyu to taisaku). Text in Japanese. Karada no Kagaku (Pop. Med.), no. 61:67-73, Jan. 1975.

Recent cases of health disturbances of epidemiological proportions are to environmental pollution caused by an error of industry or administration are described. Health disturbance symptoms due to air pollutants such as sulfur oxides, nitrogen oxides, carbon monoxide, photochemical smog, lead, fluorides, cadmium, vanadium, benzopyrene, asbestos, and other carcinogenic substances were described. Countermeasures such as the establishment of environmental standards for each pollutant and total air quality are described. Regulation of sulfur oxides has good prospects, but that of nitrogen oxides has many problems. Evaluation of the analytical value of a pollutant must be considered in relation to other values of materials. The new law which necessitates the evaluation of any new substance to be introduced in commerce will greatly contribute to environmental health.

71536

Wehrle, Paul F. and Douglas I. Hammer

SUMMARY REPORT: ILLNESSES OF CHILDREN. Preprint, American Medical Association, Chicago, Ill., 19p. 1974 (?). 25

refs. (Presented at the Air Pollution Medical Research Conference, 1974 (?).)

A tabulation of the health effects of specific air pollutants on children is presented based on a literature review of more than 100 investigations prior to 1970. Clinical and laboratory findings as well as the pollutant source are summarized for the following substances: fluorine, lead, arsenic, asbestos, silicates fatty acids, carbon monoxide, chloroprene, sulfur dioxide, hydrogen sulfide, carbon disulfide, hydrocarbons, sulfuric acid, and particulate matter. A brief review of epidemiological findings associated with major air pollution episodes is also presented.

71617

Kettner, H. and W. Erdmann

ESTIMATE OF THE HEALTH HAZARD OF THYPOPULATION BY FLUORIDE IMMISSIONS. (Die Abschaetzung des gesundheitlichen Risikos der Bevoelkerung durch Fluorid-Immissionen). Text in German. Oeffentl. Gesundheitswesen (Stuttgart), 37(1):32-36, 1975. 17 refs.

A review of foreign literature on the effects of fluorine emissions on man (adults and children) and animals is given. Mainly the effects of hydrogen fluoride, sodium fluoride, aluminum trifluoride, and Na3AlF6 are discussed. The Verein Deutsche Inginieure guideline issued in Sept. 1974 has set the following maximum allowable immission concentrations in micrograms F/cu m: hydrogen fluoride 50, aluminum fluoride, sodium fluoride and cryolithe 100, and calcium fluoride 200 over a period of 1 yr.

71933

Berry, Wade L. and Arthur Wallace

TRACE ELEMENTS IN THE ENVIRONMENT - THEIR ROLE AND POTENTIAL TOXICITY AS RELATED TO FOSSIL FUELS - A PRELIMINARY STUDY. California Univ., Los Angeles, Lab. of Nuclear Medicine and Radiation Biology, Atomic Energy Commission Contract AT (04-1) GEN 12, Rept. UCLA 12-946, 72p., Jan. 1974. 134 refs.

The nature, occurrence, and effects of trace elements in the environment are reviewed along with the identification of probable hazards of trace element emissions to the environment, particularly as a result of fossil fuel power generation. The ecology of trace elements is very delicately balanced, and small additions of some trace elements from polluting sources can significantly alter an existing ecosystem. The pathways and rates of movement of trace elements between each component of any soil-water-plant- animal system are not well defined. Generally, the lower the concentration of a trace element in nature, the higher is its toxicity. Trace elements such as cadmium and mercury are known to occur in fossil fuels in somewhat higher concentrations than elsewhere, were making the study of their emission a matter of urgency. Elements such as zinc, copper, and cobalt which are essential for life at low concentrations can be toxic at higher concentrations. The trace element composition of fossil fuels is extremely variable, resulting in a great uncertainty regarding potential toxicity problems. The fate of volatile trace elements released from fossil fuels upon combustion is largely unknown, adding further to the uncertainty. This volatile group includes: antimony, arsenic, beryllium, bromine, cadmium, fluorine, gallium, mercury, and selenium; excluding antimony, bromine, and gallium, these pose a serious hazard to man. The nonvolatile trace elements of significant abundance in fossil fuels include: boron, chromium, cobalt, copper, iodine, lead, lithium, manganese, nickel, vanadium, and zinc. These afford a lesser, but still significant, hazard. Boron is certain to present soil-plant problems whenever coal ash is applied to soil.

71948

MacEwen, J. D. and E. H. Vernot

TOXIC HAZARDS RESEARCH UNIT ANNUAL TECHNICAL REPORT: 1973 (FINAL REPORT). California Univ. at Irvine, Dayton, Ohio, Overlook Branch, Aerospace Medical Research Lab. Contract F33615-73-C-4059, Proj. 6302, Task 01, Work Unit 63020113, AMRL-TR-73-83, 170p., Aug. 1973. 38 refs. NTIS, DDC: AD-771 025

The activities of the Toxic Hazards Research Unit for the period June 1972-May 1973 are reviewed. Acute inhalation toxicity experiments were conducted on rats with mixtures of carbon monoxide and hydrogen cyanide. Acute toxicity tests on inhaled HCN for 5-minute exposures conducted in combination with CO did not show any increased toxic response at carboxyhemoglobin levels of 25% saturation. Emergency Exposure Limits (EEL) were validated for chlorine pentafluoride and 24-hour EEL of 1 ppm is proposed for monomethylhydrazine. A series of chronic inhalation toxicity studies were conducted with hydrazine, methylhydrazine, and coal tar aerosols. Oral percutaneous toxicity evaluations were conducted (to determine LD-50 values for mixed creosols, allyl isothiocyanate, methyl isothiocyanate, methyl isocyanate, ortho-nitroaniline, ethyl chloracetate, and phenyl isocyanate. (Author abstract modified)

72083

Sadilova, M. S., V. A. Kostyuchenko, E. G. Plotko, S. I. Voroshilin, V. Y. Nikiforova, and E. N. Pochashev

THE PROBLEM OF AGE SENSITIVITY OF THE BODY TO FLUORINE IONS IN THE AIR. (K voprosu o vozrastnoy chuvstvitel nosti organizma k ionu ftora v vozdukhe). Text in Russian. Gigiena i Sanit., no. 12:33-36, Dec. 1974. 4 refs.

The age-dependent sensitivity of the organism to inhaled fluorine was studied in rats. The animals were most susceptible to fluorine at the age of 1.2 to 3.9 mo and again at the age of 11.6-23.6 mo. In the first case, damage of the dental enamel, and lesions of the respiratory tract were most pronounced, while in the second age bracket animals were affected by lesions of the bones, lungs, and upper respiratory tract. Proliferation in the interalveolar septa, atrophy and focal edema of the bronchial mucosa, and hyperplasia of the peribronchial tissue were found on autopsy. The above age brackets correspond to those of 1-14 yr and 26-55 yr in humans.

72961

MacEwen, J. D. and E. H. Vernot

TOXIC HAZARDS RESEARCH UNIT ANNUAL TECHNICAL REPORT: 1974 (FINAL REPORT). California Univ. at Irvine, Dayton, Ohio, Overlook Branch, Air Force Contract F33615-73-C-4059, Proj. 6302, Task 01 13 62202F Work Unit 6302113, Rept. AMRL-TR-74-78, 200p., July 1974. 55 refs. GPO

Acute and chronic inhalation toxicity studies of various compounds of interest to the Air Force were performed using several types of laboratory animals. The studies included: the mammalian toxicity of fluomine dust (cobalt-bis (3-fluorosalicylaldehyde)-ethylenediimine), the chronic toxicity of JP-4 jet fuel, the acute toxicity of cluster marker residue (burned misch metal), coal tar aerosol studies, the acute toxicity of various amine compounds, benzonitrile toxicity, the biological effect of continuous inhalation exposure to 1,1,1,-trichloroethane (methyl chloroform), the toxicity of the photo-

graphic compounds triphenyl stibine and 1,1-bis (p-dimethylaminophyenyl)-ethylene, the effects of 6-month chronic low level inhalation exposures to hydrazine, the acute toxicity of deuterium fluoride, and determination of a 60 minute median lethal concentration for hydrogen chloride on rodents.

73658

French, Jean G.

EPIDEMIOLOGY AND CLINICAL MANIFESTATIONS OF DISEASE ASSOCIATED WITH EXPOSURE TO EMISSIONS FROM COAL AND OIL SHALE UTILIZATION. Preprint, Cincinnati Univ., Ohio, Dept. of Environmental Health, National Inst. of Environmental Health Sciences, and the National Inst. for Occupational Safety and Health, 21p., 1975. 33 refs. (Presented at the Workshop on the Health Effects of Coal and Oil Shale Mining, Conversion and Utilization, Cincinnati, Ohio, Jan. 25, 1975.)

The epidemiological and clinical implications of exposure to emissions from increased coal and oil shale utilization are discussed. Combustion products considered include: sulfur dioxide, sulfates, sulfuric acid aerosol, nitrogen oxides, nitrates, polynuclear hydrocarbons, carbon monoxide, aldehydes, and various toxic trace elements (beryllium, fluorine, arsenic, selenium, cadmium, mercury, and lead) found in fly ash. Epidemiological studies indicate that prolonged exposure to nitrogen dioxide levels of 117-205 micrograms/cu m can contribute to increased prevalence of chronic bronchitis, acute lower respiratory disease, and diminished pulmonary function. Associations between asthma attacks and levels of suspended nitrates and sulfates also exist. Human chamber studies indicate that ozone in the presence of SO2 is more irritating than ozone alone. Animal studies demonstrate high toxicities for sulfuric acid mists and various sulfate compounds which are products of the atmospheric transformation of SO2. Purified polycyclic compounds produce tumors of the trachiobroncholar tree or lung parenchyma when absorbed on particles and delivered below the larynx. The increased processing of oil shale appears to offer even greater potential than coal combustion for increasing levels of hydrocarbons, nitrogen oxides, and photochemical oxidants.

74290

Dorst, Jean

THE ACTION OF POLLUTION ON THE BIOLOGICAL EQUILIBRIUM AND ON HUMANS. (Actions des pollutions sur les equilibres biologiques et sur l homme). Text in French. Bull. Tech Inf., no. 262:655-658, 1971.

The effects of environmental pollution on the equilibrium of the ecosystem and on the human organism are discussed. Air pollution, especially particulates, sulfur dioxide, nitrogen oxides, carbon monoxide, and hydrocarbons, may cause chronic bronchitis, emphysema, cardiovascular disorders, and lung cancer. Fluorine and SO2 cause plant necrosis. Certain air pollutants exert synergistic effects with other pollutants and generate smog under the influence of solar radiation.

74369

Shizuoka Prefectural Office (Japan)

STATUS OF DAMAGES DUE TO ENVIRONMENTAL POLLUTION. SEC 1 STATUS OF HEALTH INJURIES IN FUJI DISTRICT AND ITS COUNTERMEASURES. SEC. 2. STATUS OF AGRICULTURAL CROP DAMAGE. (Kogai ni yoru higai no jokyo. Dai 1-setsu. Fuji chiiki no kenkohigai no genkyo to taisaku. Dai 2-setsu Nosakumotsu higai no jokyo to taisaku). Text in Japanese. In: Shizuoka Prefectural Environmental Nuisance White Paper, p. 254-260, 1974.

The rapid expansion of paper factories in the Fuji district of Shizuoka Prefecture resulted in increased air pollution leading to health injuries such as chronic bronchitis. The number of officially recognized air pollution patients was 360 by the end of March 1973 and 469 by the end of March 1974, including seven mortalities. The percentage of chronic bronchitis, bronchial asthma, asthmatic bronchitis, and pulmonary emphysema cases were, respectively, 6.4, 85.1, 5.5, and 3.0%. The number of such patients outside the appointed jurisdiction was 173 by the end of March 1974. Patients younger than 14 and older than 60 yr accounted for 78% of the total cases. Countermeasures included medical compensation. Agricultural crop damage was due to photochemical smog (covering 12,000 hectares) acidic rainfall, and hydrogen fluoride emissions from an aluminum refinery.

74380

Nakaya, S., S. Sakurai, K. Itai, Y. Suzuki, and F. Tsunoda

ON THE SIGNIFICANCE OF URINARY FLUORINE CONCENTRATION AS AN INDICATOR OF EXPOSURE TO FLUORIDES. (Fukka butsu bakuro shihyo to shite no nyochu fusso nodo no igi ni tsuite). Text in Japanese. Taiki Osen Kenkyu J. Japan. Soc. Air Pollution), 9(2):346, Nov. 1974. (Presented at the Japan Society of Air Pollution, National Meeting, 15th, Paper 201.)

The behavior of urinary fluorine upon long-term urine storage was investigated. When the pH of urine changes from 5-6 to 9 (2-3 mo storage at 30 C; 2-liter sample of 24-hour urine collection in polyethylene jar), because of ammonia fermentation, most of the fluorine precipitates as calcium fluoride. Thus, fluorine analysis by the direct ion electrode method would give erroneous results for total fluorine content. Storage of the 2-liter samples at 0 C maintained the pH at 6, and fluoride precipitation was not marked at the end of 2-3 mo. Storage of urine in 10-milliliter polyethylene test tubes at 0, 20, 40 C, for a 3-week period, did not result in any significant reduction in values of average fluorine content, upon analysis by the direct ion electrode method. The steam distillation method for fluorine analysis results in values 1.5 times those obtained from direct ion electrode analysis.

74580

Tsunoda, Humio

RECENT TREND IN THE RESEARCH ON HUMAN HEALTH EFFECTS OF AIR POLLUTION. (Saikin no taikiosen ni kansuru igakuteki kenkyu no doko). Text in Japanese. Iwate Igaku Zasshi (J. Iwate Med. Assoc.), 26(5):516-522, Oct. 1974. 42 refs.

The present state of air pollution in Japan is outlined with respect to the major air pollutants; and the health effects of sulfur dioxide reviewed in relation to the amendment of the air quality standard from 0.06 to 0.04 ppm daily average value. The additive health effects of SO2 and nitrogen dioxide are also described. Long-term exposure to NO2 at low concentrations causes hyperplastic foci due to the proliferation of bronchiolar epithelial cells, suggesting a relationship between NO2 in air and lung tumorigenesis. The effects of suspended particulates and carbon monoxide and differences between symptoms resulting from Japanese photochemical oxidants versus those in Los Angeles are described along with proposed criteria. The accumulation of airborne fluorides in agricultural crops is compared to its minute concentration in air.

74821

Tsuji, Yoshito

ENVIRONMENTAL POLLUTION BY FLUORIDE AND ITS INFLUENCE ON THE HUMAN BODY. (Fukkabutsu ni yoru kankyo osen to seitai eikyo). Text in Japanese. Supplement, Nippon Koshu Eisei Zasshi (Japanese J. Public Health), 21(10):73-74, Oct. 1974. (Presented at the Japanese Society of Public Health, Annual Meeting, 33rd, Fukushima, Japan. Oct. 16-18, 1974.)

The cumulative effects of fluorine on the human body are disclosed. The incidence of fluorosis (mottled teeth) increases sharply as a cumulative effect of fluorine concentrations above 1.0-1.5 ppm in the drinking water. In Japan, the threshold fluorine concentrations seem to be 0.5-0.6 ppm, although mottled teeth have occurred at fluorine concentrations of 0.3-0.4 ppm in drinking water. Prevention of tooth decay by fluoridation (1 ppm) of drinking water is considered safe, and is practiced in the United States. Low amounts of fluorine cause osteosclerosis, while large amounts cause softening of the bones. Schoolchildren with 3rd degree (heavily) mottled teeth were small in height, while those with 1st degree mottling were somewhat taller than average. In Kitakata, schoolchildren from areas of high fluoride pollution had a higher incidence of goiter, but an increase in growth with trace amounts of fluorine was also observed. Fairly rapid excretion of fluorine from the body in urine was found in studies conducted on workers from Showa Denko, Kitakata. In experiments conducted at this school with tadpoles and fertilized sea urchin eggs, the presence of 5 ppm sodium fluoride resulted in faster emergence of frog forelegs and a higher percentage of formation of normal spines on sea urchins than in the absence of sodium fluoride. At fluoride concentrations above 25 ppm, deformed sea urchins with no skeletal structures were observed.

74822

Kimura, I., H. Shioi, S. Suda, T. Yoshida, Y. Sato, N. Konno, S. Sakurai, and H. Tsunoda

ON THE EFFECTS OF ENVIRONMENTAL POLLUTION BY AIRBORNE FLUORIDES ON EXPERIMENTAL GOATS (IV). RESULTS OF 2-YEAR CLINICAL EXAMINATIONS. (Taikichu fukkabutsu no kankyo osen ni yoru yagi no bakuro jikken (Dai-4-ho). 2-Nenkan no rinsho kensa seiseki). Text in Japanese. Taiki Osen Kenkyu (J. Japan. Soc. Air Pollution) 9(2):347, Nov. 1974. (Presented at the Japan Society of Air Pollution, National Meeting, 15th, Paper 202.)

The biological effects of atmospheric fluoride pollution were investigated with seven goats raised for 2 yr (1972-1974) in an area exposed to pollution from an aluminum refinery. A control group of 4 goats was raised in a non-polluted area during the same time. Average fluorine content of pasture grasses in the pollution area was 30 ppm, 4 times as high as that in the control area. The monthly average atmospheric hydrogen fluoride concentrations during the 2 yr ranged from 0.4-1.4 micrograms/cu m. The average monthly serum fluorine concentrations in the exposed goats varied from 0.1 ppm to 0.4 ppm. The average monthly urinary fluorine concentrations for exposed goats ranged from 7 ppm to about 15 ppm. Control goats had a steady serum fluorine level of about 0.05 ppm, and urinary fluorine concentrations between 0-4 ppm. Blood tests were also taken for hematocrit; hemoglobin, protein, cholesterol, BUN, ZTT, GOT, Al-P. In general, no significant variations were found between plots for exposed and control goats, although exposed goats had higher levels of GOT, and the plots did not coincide well for cholesterol concentrations.

74823

Sato, Y., N. Konno, and F. Tsunoda

ON THE EFFECTS OF ENVIRONMENTAL POLLUTION BY AIRBORNE FLUORIDES ON EXPERIMENTAL GOATS (V). PLACENTAL TRANSMISSION OF FLUORIDE (CONTINUED). (Taikichu fukkabutsu no kankyo osen ni yoru yagi no bukuro jikken (Dai-5-ho). Fukkabutsu no taiban tsukasei (Zoku-ho)). Text in Japanese. Taiki Osen Kenkyu (J. Japan. Soc. Air Pollution), 9(2):348, Nov. 1974. (Presented at the Japan Society of Air Pollution, National Meeting, 15th, Paper 203.)

Studies were made with goats on the correlation of fluorine concentrations in maternal serum with fluorine concentrations in placenta and offspring. Goats were divided into three groups: one control, and two pollution-exposed. Offspring were jugulated after birth, and amounts of fluorine in serum, tissues, organs, and various skeletal structures were determined. Fluorine concentrations in maternal serum ranged from 0.043-0.065 ppm for the control groups, and 0.098-0.292 ppm for the exposed groups. In the offspring, serum fluoride concentrations ranged from 0.010-0.016 ppm for the control group, and 0.018-0.031 ppm for the exposed groups. Placental fluorine concentrations (2.2-4.5 ppm) were higher than maternal and offspring serum fluorine concentrations, but no significant differences were found among the three groups. In all three groups, highest and lowest fluorine accumulations were found in the same types of tissues, organs, and skeletal structures. In tissues and organs, fluorine contents were highest in the aorta (5.1-5.5 ppm) and spleen (5.4-7.9 ppm), and lowest in the brain (0.48-1.75 ppm) was muscle (0.72-1.15 ppm). In skeletal structures, fluorine content was lowest in molars (73.9-259 ppm), and highest in rib (149-569 ppm) and vertebra (152-545 ppm).

76902

Tsunoda, F., E. Aizawa, S. Sakurai, H. Kunita, and K. Sasaki

ON THE BODY POLLUTION OF INHABITANTS IN ENVIRONMENTALLY POLLUTED AREAS BY FLUORIDES IN AIR. (Taikichi fukkabutsu ni yoru kankyoosen chiku jimin no seitaiosen ni tsuite). Text in Japanese. Taiki Osen Kenkyu (J. Japan. Soc. Air Pollution), 7(2):199, Nov. 1972.

According to the urinalysis of 13 male and 17 female inhabitants living in an area environmentally polluted by fluorine from whom more than 1 liter of urine in a day were obtained, the average content of fluorine was 2.02 mg (S.D. of 0.30 mg) and 1.77 mg (S.D. of 0.43 mg), respectively. The data obtained on the urinalysis of 9 male and 13 female inhabitants living in an area not polluted by fluorine was 0.79 mg (S.D. of 0.07 mg) and 0.73 mg (S.D. of 0.07 mg). The above difference of fluorine in urea is due to the difference of the amount of fluorine on agricultural products on which fluoride in air is deposited. The average fluorine content of urine of peoples who showed spotted teeth due to excessive intake of fluoride was 1.20 (S.D. of 0.12) mg (19 males 20 - 49 yr old), 1.50 (S.D. of 0.2) mg (10 males 50-69 yr old), 1.20 (S.D. of 0.12) mg (17 females 20-49 yr old) and 1.13 (S.D. of 0.08) mg (15 females 50-69 yr old). Considering the fact that orally taken fluorine was excreted more than 50% within 12 hr, urinalysis of fluorine was a very effective indicator of fluorine pollution.

78873

Adler, Alan D., Veronika Varadi, and Nancy Wilson

PORPHYRINS, POWER, AND POLLUTION. Ann. N. Y. Acad. Sci., vol. 244:685-694, April 15, 1975. 37 refs. (Presented at the Biological Role of Porphyrins and Related Structures Conference, Oct. 23-26, 1973.)

The involvement of porphyrinic materials with pollution processes is discussed. Many of the anion pollutants, such as

cyanide and fluoride, and many of the gas pollutants, such as carbon monoxide and the nitrogen oxides, have the central iron of hemeproteins as their primary target. Many forms of heavy metal poisoning arise due to interference of these metals with the roles or biosyntheses of porphyrins. The metalloporphyrins are sensitive simple colorimetric detectors of pollutants as carbon monoxide, nitrogen oxides, cyanides, fluorides, and strong oxidants. Hemeproteins are primary targests for nitrite pollution and iron porphyrins catalyze a number different types of nitrogen oxide interactions that are of significance in areas of pollution and health.

79619

Takizawa, Y. and I. Nakamura

EFFECTS OF CALCIUM FLUORIDE ON RESPIRATORY SYSTEM. (CaF no kokyuki-kei ni oyobosu eikyo). Text in Japanese. Nippon Koshu Eisei Zasshi (Japan. J. Public Health), 22(10):400, Oct. 1975.

Wistar adult female rats were exposed to calcium fluoride dust at 27(?)/cu m, 4 hr/day for 10 and 30 days. Rats were sacrificed 24 hours after the last exposure of each day. The findings were: (1) fluorine in exposed rat s urine increased to 2.3 times as high as in the control group after 15 days of exposure, (2) fluorine in the rat s serum became about 2.5 times as high as the control; however, this was not dependent on length of exposure, suggesting a small accumulation of fluorine in serum, (3) fluorine in the lung was notably higher, followed by spleen, liver, heart and kidney in the order, (4) fluorine in femurs and incisors tended to increase with exposure, histologically, in rats exposed for 10 days (5) edema in bronchiolar mucous epithelium and intramucosal epithelium, infiltration of neutrocytes, appearance of plasmocytes in the mucosal proper layer, smoothing of mucosal epithelium, lling of the alveolar epithelium, and fall-out of alveolar epithelium and phagocytes into the alveolar cavity were observed, in rats exposed for 30 days, (6) disappearance of the edema and the filtration, increase of appearance of plasmocytes and of smoothing of the mucosal epithelium, swelling of the alveolar epithelium, increase of fall-out of alveolar epithelium and phagocytes into the alveolar cavity, stagnation of acidphile substances in the alveoli, agglomeration of plasmocytes around small vessels, and increase of cells on alveolar septa without fibrous thickening and glassy membrane were also observed.

79623

Nakamura, I. and Y. Takizawa

EFFECTS OF FLUORIDES ON RESPIRATORY SYSTEM OF RAT. (Rat kokyukikei ni oyobosu fukkabutsu no eikyo). Text in Japanese. Taiki Osen Kenkyu (J. Japan. Soc. Air Pollution), 10(4):479, Nov. 1975.

Groups of adult female Wistar rats were exposed by inhalation to sodium fluoride at 13 mg/cu m and to calcium fluoride at 25 mg/cu m for 4 hr/day for, respectively, 10 days and 10 and 30 days. All the rats were sacrificed for 24 hours after the last exposure. The fluorine content of the urine of rats exposed to NaF increased rapidly, and that of CaF2 rats showed slower increase; the former at 10 days of exposure was 3.5 times higher than the latter. The fluorine concentration in serum was about 6 times higher in the NaF group than in the CaF2 group after one day of exposure; however, the absolute concentration 24 hours of the last exposure was about the same as that of the unexposed control. The fluorine concentration in the lung of rats exposed to CaF2 was higher than those in other organs and showed increase with exposure time, in contrast to that of the group exposed to NaF. The fluorine content of the femur of the rats exposed to NaF was significantly higher than that in the control group. Pathological findings include swelling of alveolar epithelium, reinforced omission of the alveovacuolar phagocyte, stagnation of acidphilic substances in the alveoli, aggregation of plasma cells around small vessels and proliferation of cells in the pulmonal septum, without, however, fibrous thickening or formation of hyaline membrane. These findings suggest species differences of fluorides in metabolism in the body.

79634

Nakaya, S., K. Itaya, S. Sakurai, Y. Suzuki, and F. Tsunoda

STUDIES ON AIR POLLUTION DUE TO FLUORIDES PART 16. ON THE FLUORINE CONTENT IN URINE AND SERUM OF INHABITANTS AROUND PHOSPHATE FERTILIZER FACTORIES. (Fukkabutsu ni yoru taikiosen ni kansuru kenkyu Part 16. Rin-hiryo kojo shuhen chiku jumin no nyochu kesseichu fusso nodo ni tsuite). Text in Japanese. Nippon Koshu Eisei Zasshi (Japan. J. Public Health), 22(10):399, Oct. 1975.

The fluorine content in urine and blood serum of men and women living in the area of phosphatic fertilizer plants for more than five years, and of primary school boys in the 5th and 6th years of classes was determined. The area studied was within a radius of 1 km from a fused phosphatic fertilizer factory and within 2 km (to the SE), 2 km (to the NW) and 7.5 km (to the W) from a superphosphate factory. The fluorine content of urine and serum was higher as distance from the factory decreased; however, there were no data showing health impairment due to fluorine.

79796

Sukeda, Y., E. Mikami, Y. Sato, and T. Yamamoto

ON THE DYNAMIC STATE OF IONS AND THE RELATING ENZYME ACTIVITY IN FLUORINE-POISONED RATS. (Fusso-chudoku rat ni okeru ion-dotai to sono kanken koso kassei ni tsuite). Text in Japanese. Taiki Osen Kenkyu (J. Japan. Soc. Air Pollution), 10(4):516, Nov. 1975.

The effects of airborne fluorides deposited on pastures and taken by domesticated animals is of interest. Sodium fluoride was p.o. administered to male Wister rats at a rate of 2.3 mg fluorine/100 g body weight, and the effects were observed. The concentration of fluoride ion in the blood reached its maximum, 2.2 ppm, after 30 min of administration, then decreased slowly to 0.2 ppm after 15 hours. Urinary fluoride was highest during the first day of tests, with a conspicuous increase of urinary phosphate ion. Magnesium ion showed a small increase and calcium ion showed a small decrease in the urine. Serum alkaline phosphatase activity showed an increase; however, acidic phosphatase activity and renal-alkaline and renal-acidic phosphatase activity showed a decrease. The ATPase in renal cortex activity increase with administration of sodium fluoride and sodium chloride, compared to the control group. However, the activity in rats administered sodium fluoride was inhibited when compared to that in rats administered sodium chloride.

79848

Napier, D. H.

ASPECTS OF POLLUTION ASSOCIATED WITH THE PROCESS INDUSTRIES. Preprint, Imperial College of Science and Technology, London (England), Dept. of Chemical Engineering and Chemical Technology, 24p., 1974 (?).

Environmental effects associated with gaseous and particulate air pollutants generated by process industries are reviewed. Specific pollutants discussed include: oxygen, nitrogen, carbon monoxide and carbon dioxide, sulfur dioxide, methane,

ethylene, hydrogen, ammonia, chlorine and fluorine, nitrogen oxides, ozone, vinyl chloride, hydrogen sulfide, mercury, lead, cadmium, beryllium, cyanides, chlorinated compounds, asbestos, proteolytic enzymes, mutagens, carcinogens, and teratogens. Topics covered include: th interactions of various pollutants in the environment, methods for the disposal of toxic substances, threshold limit values for the above pollutants, occupational exposure to air pollutants, the introduction of pollutants into the environment, natural sinks for environmental pollutants, and the effects of pollutants on the surrounding flora and fauna.

79980

Favino, A. and G. Catenacci

POLLUTION BY FLUORINE. (L inquinamento da fluoro). Text in Italian. Med. Lavoro (Milan), 64(3-4):132-142, March-April 1973. 36 refs.

Fluorine pollution is caused by the discharge of gas, liquid, and solid effluents from industries using fluorine compounds which are extremely stable, and by substances contaminated by fluorine. Chronic intoxication of organisms is related to the liberation of soluble ionic F, which is absorbed in the digestive tract: insoluble compounds are significantly less harmful. Acute intoxication centers in the respiratory tract and is expressed, in the case of inorganic compounds, by severe lesions of the lung cells, and in the case of organic compounds, by major pulmonary clearance with a high Ostwald coefficient. In general, damaging effects on biological structures manifest themselves as multiple and diffuse lesions of an abiotrophic type and an irreversible nature. It affects the growth of vegetation and the fertility of animals, in which it produces considerable deformities; skeletal deformations have already been observed in children from Japanese industrial areas.

80078

Schellmann, B. and A. Zober

NORMAL VALUES OF FLUORIDE FROM A DEFINED REGION OF THE HUMAN ILIAC CREST. Int. Arch. Occup. Environ. Health, 35(3): 233-244, 1975. 32 refs.

Normal fluoride concentrations in the human iliac crest were determined by analysis of bone ash from 100 cadavers of both sexes. The bone samples were taken from exactly the same skeletal location to allow for direct comparison with samples derived by bioptical methods from living subjects. The analysis was carried out on samples of dried bone ash with an ion sensitive electrode. Statistical analysis of the results indicates a positive linear relationship between fluoride content and age.

80197

Mazliak, P.

PHYSICOCHEMICAL FACTORS OF THE PENETRATION OF TOXIC SUBSTANCES. (Facteurs physico-chimiques de la penetration des toxiques). Text in French. Ann. Nutr. Aliment, 28(4):277-296, 1974. 10 refs.

The physicochemical factors involved in the penetration of toxic substances into cells were studied on a model. The penetration of a foreign substance into the cell is determined by such factors as the chemical nature of the cell membrane, the cytoplasm, and the foreign substance, and by the molecular organization of the membrane and of the cytoplasm. The central hydrophic zone of the cell membrane plays the major role in the penetration of the toxic substance, as the passage through the hydrophilic outer zone and the passage from the central lipophilic zone into the aqueous medium of the cytoplasm are fairly easy. Halogens, gaseous halogenides, gaseous sulfur and nitrogen compounds, compounds of phosphorus and arsenic, carbon oxides, carbon sulfides, gaseous hydrogen, cyanide, hydrocarbons, acetone, methylene chloride, dichloroethylene, trichloroethylene, toluene and its derivatives penetrate through the cell membrane by simple diffusion. The penetration of solid fluorides, fluorosilicates, mercury, copper, lead, and chromium involved active transport or a diffusion mechanism implying a bond with the membrane proteins.

80857

Newman, James R.

ANIMAL INDICATORS OF AIR POLLUTION. Inst. of Environmental Sciences, Mt. Prospect, Ill., Inst. Environ. Sci. Energy Environ., Annu. Meet., 21st, Anaheim, Calif., 1975, p. 152-154. 5 refs. (April 13-16.)

An analysis of the feasibility of using animals as biological indicators of air pollution is presented. Most animals found to be potential biological indicators are fairly common in the environment, and all are easily sampled. Some groups like domestic animals and zoo animals are particularly easy to monitor; game animals which represent more natural conditions are also easy to monitor. The four best responses of biological indicators used for providing specific information on specific pollutants are: physiological changes observed at autopsy or during histological examination, residue accumulation, changes in blood chemistry and physiology, and changes in the morphology or appearance of the animal. Air pollutants can be generally classified in terms of being permanent accumulators, temporary accumulators, and non-accumulators. A list of possible biological indicators of air pollution is provided and includes the following air pollutants: carbon monoxide, fluoride, hydrogen sulfide, nitrogen dioxide, sulfur dioxide, arsenic, lead, molybdenum, particulates, photochemical oxidants, selenium, and vanadium.

81018

Suzuki, Y., S. Sakurai, K. Itai, S. Nakaya, K. Yazaki, and F. Tsunoda

EXPOSURE EXPERIMENTS OF GOATS TO ENVIRONMENTAL POLLUTION DUE TO FLUORINE IN AIR PART VII. FLUORINE CONTENT OF ITS TISSUES. (Taikichu fukkabutsu no kankyoosen ni yoru yagi no bakuro jikken Part 7. Soshiki no fusso ganyuryo). Text in Japanese. Taiki Osen Kenkyu (J. Japan. Soc. Air Pollution), 10(4):481, Nov. 1975.

Goats were reared in an area where the concentration of hydrogen fluoride in the air was 0.5-1.0 ppb, and their 7th thoracic vertebra, the central part of the rib, the ilium, and the muscles of the haunch were analyzed for fluorine by an ion electrode method. The fluorine content of the thoracic vertebra and rib was 545-570 ppm just after birth, four times greater than for the control group, and it increased markedly with time, reaching in 3 months the level which the control group attained in 3 years. After 3 years, the fluorine content became 8000 and 6000-7000 ppm in the thoracic vertebra and in the rib and ilium, respectively, 3.6-4.3 times that of the control. In the muscles, on the contrary, the fluorine content remained at about 1.0 ppm for 3 years, showing no difference with the control. The pollution of goats by fluorine is probably via polluted pasturage rather than inhalation.

81181

Ozaki, Kyosuki, Hiroshi Ando, Yoichi Nabeshima, Yoshiyuki Nuno, Shigehiko Hattori, Shogo Yamamoto, Shinsaku Myojo,

Tsuneyoshi Onishi, Reiko Kawabata, Kyoko Watanabe, Kangen Jinno, Kyoko Shiraishi, Minekatsu Taniya, Hiroshi Toyota, and Yutaka Kurokawa

THREE YEAR STUDY OF HEALTH EXAMINATION AT IWANABE FROM 1970, MAINLY ON THE EFFECTS OF FLUORIDE. Text in Japanese. Ehime Kenritsu Byoin Gakkai Kaishi (Ehime J. Med.), 12(2):66-71, Nov. 1974. 6 refs.

Partial damage to rice plants probably due to fluorides from an aluminum electrolysis factory in Niihama, followed by findings of abnormally high amounts of fluorine in rice plants and grain led to medical examinations and measurement of fluorides in 1970. Control measures at the factory led to a decrease in the concentration of hydrogen fluoride in the air, from 7-8 ppb in March 1969 to 0.4 ppb in March 1972. The plant damage was most apparent on gladiolus and pine trees. The amount of fluorine in daily urine varied by family and age, suggesting that inhaled air is not the important factor. On the other hand, the inhabitants complain of sticking in the throat and tiredness of the legs, although these complaints are decreasing with time. The problem of fluorine pollution has been settled by the efforts of industry and mass migration of inhabitants from the area.

81250

Francon, F. and P. Grellat

FLUOROSIS. A POLLUTION SOURCE YET IGNORED: FLUOROSIS HAZARDS IN SAVOY. (La fluorose. Une source de pollution encore meconnue: les ravages du fluor en Savoie). Text in French. Concours Med. (Paris), 97(16):2755-2756, 2759-2760, 1975. 29 refs.

Effects of air pollution due to fluorine and its compounds on plants, animals, and humans are reviewed. In high concentrations, fluorine is harmful for plants, especially for fruit trees and conifera. Fluorine is hazardous for insects, including honey-bees, and especially for herbivorous animals. It causes cachexia, osteomalacia, and spontaneous bone fractures in cattle. Industrial emissions are hazardous for humans, causing osteopetrosis after a long latency period, especially in the pelvis region. Osteopetrosis in an aluminum factory worker is reported; sudden elimination of the fluorine and normalization of the bones occurred 10 *yr* after cessation of the exposure.

83177

Tsunoda, F.

EFFECTS OF FLUORINE COMPOUNDS ON MAN, AS AIR POLLUTANTS AND IN WORK PLACES. (Shokuba to taikiosenbutsu to shite no fukkabutsu no ningen e no eikyo). Text in Japanese. Rodo no Kagaku (Dig. Sci. Labor), 31(4):10-16, April 1976. 12 refs.

Human injury by fluorine compounds in air has been experienced far more than 40 years in factories, but fluorine compounds as air pollutants were first recognized as a toxicant to plants and animal feed crops. Two cases of fluorine intoxication, one in a work place and the other affecting the general population directly in air and via other environmental routes are described. The primary health disturbance by inhalation of fluorine compounds involves the face, nose and eyes; no injury was found by inhalation at less than 10 ppb. The accumulation of fluorine from air to plants has been an important problem. The human intake of fluorine via several routes is illustrated. Chronic symptoms include macular teeth and osteosclerosis; dose-response relationships are known for the symptoms of both. Urinalysis of fluorine is described, emphasizing the accumulation of fluorine from the air in vegetables.

83179

Yoshikawa, H.

INTOXICATION BY FLUORIDES. (Fukkabutsu chudoku). Text in Japanese. Rodo no Kagaku (Dig. Sci. Labor), 31(4):4-9, April 1976.

General problems of fluorides in ecological systems and of the toxicity of fluorides are outlined. The natural background concentration of fluorine in air is 0.01-3.9 microgram/cu m and that in drinking water is from trace to 10 ppm, in most cases less than 0.1 ppm. The fluorine compounds to which workers are exposed include molecular fluorine, hydrogen fluoride, and several metal fluorides. The toxicity of inorganic fluorine compounds is stressed, including gaseous fluorine, hydrogen fluoride, silicon tetrafluoride, boron trifluoride and oxygen difluoride. The health hazard of fluorine compounds is described in detail for inhalation and absorption from skin by contact with fluoride particles in air. Chronic intoxication due to fluorine compounds, fluorosis, is described in detail.

83798

Tanizawa, Y.

EFFECTS OF FLUORINE COMPOUNDS ON MAN, AS AIR POLLUTANTS. (Taikiosen butsu to shite no fukkabutsu no ningen e no eikyo). Text in Japanese. Rodo No Kagaku (Dig. Sci. Labor), 31(4):17-21, April 1976. 1 ref.

Air pollution due to fluorine compounds has accompanied the increase of aluminum and phosphate fertilizer production. While plant damage due to airborne fluorine compounds has been widely publicized, human injury has not. Refrigerants, plastics, drugs and missile propellants are sources. In Japan the ambient fluorine concentration is 0.1-0.5 microgram F/cu m in larger cities and 0.1-0.3 microgram F/cu m in smaller cities. Epidemiological information on the effects of airborne fluorine compounds on humans is given, including results of medical examinations. Urinary fluorine, the frequency of macular teeth, the frequency of complaints of cough, sputum, and stridor, cases of osteosclerosis and of ECG findings, and thyroidal function disturbance, all of which indicate the degree of human injury due to fluorine, are described. The route of fluorine intake into the human body and the relationship of respiratory diseases such as chronic bronchitis, asthmatic bronchitis, bronchial asthma, and pulmonary emphysema to ambient fluorides around an aluminum refinery are described in detail.

84137

Monturiol, J. M., J. Artalejo, J. Garrido, and J. Ruiz Zubero

SURVEY METHOD FOR CHRONIC BRONCHITIS. RESULTS OF A PILOT STUDY IN THREE DIFFERENT POPULATION GROUPS. (Metodologia de las encuestas sobre la bronquitis cronica. Resultados de una encuesta piloto en tres grupos de poblacion). Text in Spanish. Rev. Enf. Torax, 23(80-89):81-108, 1974. 13 refs.

The results of a survey on the incidence and causes of chronic bronchitis (CB) carried out during 1972 and 1973 by means of a questionnaire submitted to 7806 subjects (5996 men and 1810 women) chosen from three different segments of the population (5634 employees of Standard Electrica of Madrid; 609 persons from various districts of Guadalajara; 1563 inhabitants of six agricultural villages from the Madrid region) are reported. The CB found in 1006 (12.86%) of the subjects was attributed to cigarette smoking (75.15% of the men and 10% of the women were smokers), and to socioeconomic conditions or cold climate. Environmental pollution at the existing levels did not influence the appearance of CB, as exemplified in the vil-

lages of the Madrid region (308/1563 subjects with CB) with clean air but a high number of smokers among the men (76.19%), cold winters and the lowest average salaries of the three groups sampled. Occupational air pollution, however, is considered a high risk factor, especially when associated with cigarette smoking. Of 860 workers at Standard Electrica (SE) subjected to occupational exposure to air pollution for one year or more, 207 (24%) developed CB; 402 were exposed to dust (emery, wood, etc.), 330 to irritating chemical smoke or gases from electrolytic baths (chromium, cyanides, trichlorethylene, cadmium, nickel, fluorine, carbon monoxide and carbon dioxide, welding fumes, varnish naphtha and synthetic or cellulose dyes, 128 were exposed to various types of occupational air pollution for at least one year before being hired by SE; 661 were cigarette smokers. Of 2656 SE workers not exposed to air pollution risks, only 290 (10.9%) developed CB; 2029 were smokers. A national survey using the British Medical Council - type questionnaire is recommended by the authors.

84233

Gylseth, Bjorn and Jorgen Jahr

SOME HYGIENIC ASPECTS OF WORKING IN ALUMINUM REDUCTION POTROOMS WITH SPECIAL REFERENCE TO THE USE OF ALUMINA FROM THE DRY- CLEANING PROCESS OF SODERBERG POT-GASES. Staub, Reinhaltung Luft, 35(12):430-432, 1975. 6 refs.

An increase in subjective symptoms such as irritation of the mucous membranes, headache, and nausea was registered by the workers in an aluminum reduction plant when the alumina from a dry-regaining construction (secondary alumina) was used. There was a statistically significant difference between the working conditions in the potrooms using the secondary alumina. The difference was related to airborne dust as well as gaseous and particulate fluorides. The content of potential carcinogenic polynuclear aromatic hydrocarbons (PAH) in the secondary alumina and in some airborne dust samples was determined by gas chromatography in the cyclohexane soluble fraction of these samples.

84236

Pilet, P. E. and M. Bejaoui

INTERACTIONS BETWEEN FLUORIDE, CALCIUM AND MAGNESIUM ON THE O2 UPTAKE BY TISSUES CULTIVATED IN VITRO. (Interactions entre le fluor, le calcium et le magnesium sur l Absorption de l oxygene par des tissus cultives in vitro). Text in French. Biochem. Physiol. Pflanzen, 168(5/6):483-491, 1975. 30 refs.

The combined and separate effects of calcium (++), magnesium (++), and fluorine (-) concentrations on young Rubus hispidus L. neoformations. Exposure to Ca(++) stimulated absorption of oxygen up to a .00125 M concentration of calcium chloride; Mg(++), however, was an inhibitor; the O2 absorption value remained the same for all Mg(++) concentrations used. Both Ca(++) and Mg(++) will reduce the inhibiting action of F(-) on O2 absorption. Thus, they protect the tissues against F(-) more effectively as their concentrations increase and that of F(-) decreases. When Ca(++) and Mg(++) are simultaneously present and F(-) is absent, O2 absorption is stimulated. Low concentrations of F(-) will not prevent O2 absorption from being stimulated by Ca(++) and Mg(++) together at a .00125 M concentration. This concentration, however, as well as higher concentrations will not inhibit high rates of F(-).

84260

Antweiler, H.

EFFECT AND LIMITS OF GASEOUS AIR POLLUTANTS. (Einwirkung und Grenzwerte gasfoermiger Luftverunreinigungen). Text in German. Oeffentl. Gesundheitswesen (Stuttgart), 37(9):513-519, 1975.

The most important groups of noxius gases and vapors, the type and mechanism of their effect on man, and limits to prevent health damage are reviewed. Four different groups were differentiated: (1) irritants, (2) asphyxiators, (3) anesthetics and narcotics, and (4) systemic gases effective subsequent to resorption. Among those in group (1) were aldehydes, ammonia, hydrogen chloride, hydrogen fluoride, sulfur dioxide, and sulfur trioxide, all of which attack the upper respiratory tract; and halides and ozone that attack the lungs. The terminal pulmonary region (alveoli) was the target of phosgene and nitrogen dioxide. Group (2), carbon dioxide, helium, methane, ethane, nitrogen, and nitrous oxide, disturb oxygenation of the tissues, and diluted atmospheric oxygen. Others, such as carbon monoxide, nitrobenzene, hydrogen cyanide and hydrogen sulfide disrupt O2-transport or tissue oxygenation. The gases in group (3), acetylene, ethylene, propane, acetone, and alcohols, had a depressant effect on the CNS. Systematically effective gases in group (4), halogenated hydrocarbons, benzene, phenol, carbon disulfide and methanol, act on visceral organs, hematopoiesis and the CNS. Problems of industrial toxicology relating to operations in more or less enclosed industrial spaces, involve the whole spectrum of noxious gases and vapors because of their acute danger, due to accidents, or their health damage attributable to long-term exposure. The situation of atmospheric pollution by virtually innumerable substances, among them numerous gases and vapors, was different since only a relatively small number of the latter occurred at health-threatening concentrations. Smog catastrophes have recently occurred in various locations all over the globe, the result of inverted climatic conditions and the absence of air flow. Gases, vapors and floating particles from industrial and residential sources near ground level caused the death of people with chronic bronchitis and emphysema.

84266

Tsunoda, F.

EFFECTS OF FLUORIDES IN THE AIR ON HUMAN BODY. (Taiki-chu no fukkabutsu ni yoru jintai eikyo). Text in Japanese. Taiki Osen Kenkyu (J. Japan. Soc. Air Pollution), 10(4):210-214, Nov. 1975.

Although a dose-response relationship was established for the more than 130 million persons drinking potable water with added fluorine (around 1 ppm), the effects of fluorides in air on the human body could not be simply evaluated by such a dose-response relationship because of the accumulated pollution on agricultural crops. It is necessary first to measure the fluorine in fluorine-polluted food crops. Experiments with humans given a standard diet for 5 days, then a diet from crops grown in a fluorine polluted area for 2 days, and then standard diets again for 3 days were conducted. The fluorine intake was 1.6-2.1 mg/day from the standard diet and 7.5-8.2 mg/day from polluted crops. From analysis of feces and urine of animals it was determined that accumulation of fluorine is conspicuous only in hard tissue (5000 ppm and 3000 - 4000 ppm in the dried fat of cows and sheep respectively after 3 years: 4 times that of control animals). Human absorption and excretion of sodium fluoride was measured. Slight irritation of mucosa and skin and a decrease of pulmonary ventilatory function was found epidemiologically; however, the result of long-term exposure

to concentrations of less than 10 ppb was not known. The average content of fluorine in the urine of Japanese males is 0.69 plus or minus 0.58 mg/day.

84531

Suzuki, Y., S. Sakurai, and F. Tsunoda

STUDIES ON AIR POLLUTION DUE TO FLUORIDES. PART 18. ON THE NORMAL CONCENTRATION OF FLUORINE IN JAPANESE BONES. (Fakkabutsu ni yoru taikiosen ni kansuru kenkyu. Part 18. Nihonjinno kotsu-chu fusso nodo no seijo chi ni tsuite). Text in Japanese. Nippon Eiseigaku Zasshi (Japan J. Hyg.), 31(1):175, April 1976.

Reports that high accumulations fo fluorine have occurred in the hard tissues of goats grown under conditions of air pollution from fluoride suggested the possibility of evaluation of physiological pollutions and of diagnosis of osteoscleorosis due to fluorine by analyzing the fluorine. The fluorine content of Japanese skeletons was taken as a standard. Fluorine was distributed relatively evenly in all bones. In persons older than 60 yr, the ash base fluorine content differed a little by position; however, in general, it was higher in men than in women, 1250-1500 and 850-1250 ppm, respectively. With age (older than 30), fluorine content showed a slowly increasing tendency.

H. EFFECTS-PLANTS AND LIVESTOCK

00137

M. Treshow

RESPONSE OF SOME PATHOGENIC FUNGI TO SODIUM FLUORIDE. Mycologia 57, (2) 216-21, Apr. 1965.

Growth rate of the 7 fungus isolates investigated was affected when sodium fluoride was incorporated in the substrate. Minimum concentrations required to inhibit growth varied greatly among species ranging from as low as 0.0005 M for Pythium debaryanum to as high as 0.01 M for Verticillium albo-atrum and Helminthosporium sativum. Growth rates of Alternaria, Botrytis and Colletotrichum species were suppressed when the fungi were grown at 0.005 M NaF and higher. Since the rate of growth was considered far more meaningful with regard to pathogenicity, radial growth measurements comprised the bulk of the study. Stimulation of the growth rate of some fungus species at certain concentrations of NaF was also evidenced. Growth of both Botrytis and Colletotrichum species was accelerated by NaF concentrations of 0.001 M. Spore production of B. cinerea was markedly inhibited at higher NaF concentrations. Such an effect could be particularly significant under field conditions if it occurred. Sporulation of other species was not sufficient for the possible effects of NaF to be definite. The response of fungi to NaF in all instances was most pronounced near the optimal temperature for growth of the species in question. This relation of temperature to growth response may be associated with the rate of the NaF uptake. The more rapid growth at optimal temperatures would cause a more rapid relative uptake of fluorides during a shorter period of time causing a higher fluoride buildup. It is the fluoride in the cell which is most significant; not the concentration to which the cells are exposed.

00187

H. M. Benedict, J. M. Ross, and R. W. Wade

THE DISPOSITION OF ATMOSPHERIC FLUORIDES BY VEGETATION (FINAL REPT.). Stanford Research Inst., South Pasadena, Southern California Labs., Apr. 1963. 28 pp.

Alfalfa, orchard grass, chard, endive, spinach, and romaine lettuce were grown in sand culture and fumigated with hydrogen fluoride in the atmosphere at concentrations primarily under 1.0 microgram/cu m. The fumigations were continuous for periods as long as 4 months. Under the conditions of the experiments, no significant effects of the fluorides were found on the growth of aboveground portions of the plants as long as the leaves did not develop any markings ascribable to the fluorides. The results indicated that the growth of the roots may have been suppressed slightly by the fumigations. Additional studies are needed to verify this result. Analysis of plant organs and tissues indicated that the fluorides were taken in by the leaves or chlorophyll-bearing tissue (stems of alfalfa) and translocated to the leaf extremities. No evidence of downward translocation was found. (Author)

00240

G. Dean M. Treshow

EFFECTS OF FLUORIDE ON THE VIRULENCE OF TOBACCO MOSAIC VIRUS IN VITRO. Utah Acad. Arts Sci. Proc., 43, May 18, 1966. 4 pp.

This study was begun to determine if any relationship existed between fluoride concentrations in plant foliage and the activity of viruses. Initially, it was of primary concern to develop a technique to detect the possible influence of fluoride levels below those causing visible symptoms on the infectivity of tobacco mosaic virus. In vitro studies were conducted in order to minimize the variance of results. Numerous research modifications were investigated to increase and quantify the number of lesions thereby increasing the reliability of the bioassay test as well as provide a basis for evaluating possible effects of fluoride on virus pathogenicity. Some of the questions in developing this bioassay technique were: Could fluoride be introduced into the leaves, the tissues kept viable, and the virus inoculation carried out? Another important question was: Is the fluoride contributing to the increase in lesion count or are other stress conditions of the technique primary contributions? Despite the many variables encountered which affected lesion development, fluoride content of the leaves also appeared to be a factor where tobacco mosaic virus was concerned. At least this was the case under laboratory conditions where the variability could be minimized. Under field conditions where virulence would be influenced by so many more factors, the effect of fluoride may prove to be negligible or not detectable. Even where close control of variation was maintained under in vitro conditions, results were not completely consistent. On the whole though, the slight stimulation of virus activity at foliar fluoride levels of 200 to 300 ppm appeared significant. The suppression of lesion development at higher fluoride levels was far more striking and proved to be statistically significant. (Author)

00265

H. M. Benedict, J. M. Ross, and R. H. Wade

SOME RESPONSE OF VEGETATION TO ATMOSPHERIC FLUORIDES (FINAL REPT.). J. Air Pollution Control Assoc. 15(6):253-255, June 1965.

A study was made of the effects of environmental conditions on fluoride uptake from the atmosphere and of internal fluoride on cell wall permeability. The significant results obtained indicated that alfalfa plants fumigated with hydrogen fluoride at night accumulated fluoride about as rapidly as plants fumigated during the day for the first three days. However, most of the fluoride accumulated at night could be washed off the plants, indicating it was adsorbed on the surface rather than taken into the plants. After three days, the plants fumigated during the day showed a much more rapid accumulation of fluoride than those fumigated at night. When the roots of plants are maintained in water cultures at 30 C, the uptake of atmospheric fluroide by the tops was much less than when the roots were held at 20 C even though the air temperature surrounding the tops of the plants was idential. The

results suggest that additional studies on temperature effect on fluoride uptake by vegetation would be a fruitful field of investigation. Preliminary results indicate that the cell walls of plant tissues which have absorbed fluoride from the atmosphere have an increased permeability to solutes, based on electrical resistance of water extracts. Again, further study is needed to verify this point. (Authors' abstract)

00266

H. M. Benedict, R. H. Wade, and J. M. Ross

SOME CHEMICAL AND PHYSICAL CHARACTERISTICS OF FLUORIDE COMPOUNDS AFTER CONCENTRATION BY PLANTS IN LEAVES (FINAL REPT.). Stanford Research Inst., South Pasadena, Southern California Labs. Apr. 1963. 16 pp.

Plants of orchard grass, alfalfa, and romaine lettuce which had been exposed to atmospheric fluorides were dried, or frozen and then dried, then extracted with various solvents. The solvents were applied either singly, followed by water, or in successive series, ending or beginning with water. The micrograms of fluoride recovered by each solvent and remaining undissolved in the residue were determined and expressed as such or expressed as parts per million of the dry weight of the original material. The results show that: (1) Freezing the tissues increases the ease with which fluorides are extracted by the various solvents, especially water; (2) The greatest proportion of the fluorides are extracted by water whether preceded or followed by organic solvents; (3) Of the organic solvents used, the petroleum ether extracted the most fluoride from the plants, but the ratio of the amount thus extracted to the amount extracted by water was similar to the ratio obtained when pure potassium fluoride was extracted by these solvents; (4) The actual amount of fluoride unextracted by the various solvents is approximately the same for fumigated and control plants; and (5) The proportion of fluorides extracted by water is much greater from the fumigated plants than from the control plants. From all of these studies it is concluded that practically all of the fluorides absorbed as hydrogen fluoride by plants from the atmosphere is retained in living cells in a water-soluble, presumably inorganic form, although small quantities of organic fluorides appear to be present. (Authors' abstract)

00301

M. D. Thomas

GAS DAMAGE TO PLANTS. Ann. Rev. Plant Physiol. 2, 293-322, 1951.

A detailed review is given of gas damage to plants with references containing important bibliographies. Investigations on the effects on vegetation of sulfur dioxide, other sulfur-containing gases, halogens and hydrogen halides, nitrogen oxides, ammonia, mercury vapor, and carbon compounds are cited and results discussed. Phytotoxicities of the different gases seem to depend on (a) absorbability, which is related to water solubility and reactivity with the tissues; (b) acidity or alkalinity; (c) oxidation or reduction reactions; (d) hormonal properties; and (e) toxicity of the element itself. Carbon monoxide, hydrogen cyanide and hydrogen sulfide are of comparatively low toxicity. Greater toxicity is evidenced by chlorine and sulfur dioxide due to their rapid oxidizing or reducing properties. The even greater toxicity of fluorine and iodine compounds is due to their rapid absorption and inherent toxicity as elements in themselves.

00600

J.S. Cass

FLUORIDES: A CRITICAL REVIEW. IV. RESPONSE OF LIVESTOCK AND POULTRY TO ABSORPTION OF INORGANIC FLUORIDES. J. Occupational Med. Vol. 3(10):471-477, Oct. 1961.

Author reviews the biological and toxic effects of fluorides on animals. Presented are two charts depicting the response of domestic animals to various levels of fluoride dosage, minimal response and lethal response. A portion of the review is directed to intoxication and poisoning by fluorides and the conclusion by the author is there is no evidence in the literature of the development of a satisfactory or certainly beneficial treatment for animals that have been poisoned by fluoride, aside from symptomatic or supportive measures.

00631

D. C. McCune, A. E. Hitchcock, J. S. Jacobson, and L. H. Weinstein

FLUORIDE ACCUMULATION AND GROWTH OF PLANTS EXPOSED TO PARTICULATE CRYOLITE IN THE ATMOSPHERE. Contrib. Boyce Thompson Inst. Vol. 23(1):1-12, Mar. 1965.

The effects of air-borne particulate cryolite on the fluoride accumulation and growth of gladiolus, Milo maize, corn, tomato, and alfalfa were studied in a series of experiments using exposure periods of 9 to 49 days and atmospheric fluoride concentrations of 1.2 to 15 microgram cubic meter. Exposure to cryolite resulted in 2- to 50-fold increases in the fluoride level of foliage depending upon the duration of exposure, the atmospheric fluoride level, and the species or variety of plant. Except for a small increase in tip burn over plants exposed to ambient air in gladiolus, exposure to cryolite produced no visible injury and there was no effect of cryolite on growth or yield. A comparison of the effects of an Alconox-EDTA wash and position in the leaf on tissue fluoride levels in gladiolus exposed to HF and cryolite indicates that the relative inactivity of cryolite results from an inability of the accumulated fluoride to penetrate the leaf in a form that is physiologically effective. (Author summary)

00633

A. E. Hitchcock, L. H. Weinstein, D. C. McCune, and J. S. Jacobson

EFFECTS OF FLUORINE COMPOUNDS ON VEGETATION, WITH SPECIAL REFERENCE TO SWEET CORN. J. Air Pollution Control Assoc. 14, (12) 503-8, Dec. 1964. (Presented at the 57th Annual Meeting, Air Pollution Control Association, Houston, Tex., June 21-25, 1964.)

Since 1951 many fumigation experiments have been carried out with different species and varieties of plants, including field corn and sweet corn. Results for gladiolus and Milo maize have been summarized, but only brief mention has been made of results obtained with corn. This report summarizes some of the earlier results obtained with sweet corn, used alone or in comparative tests with field corn in unreplicated experiments and the results of replicated fumigation experiments with Marcross sweet corn (Zea mays L.) and lamb's-quarters (Chenopodium album L.) carried out in 1963. (Author abstract)

00654

L. Ordin

EFFECT OF AIR POLLUTANTS ON CELL WALL METABOLISM. Arch. Environ. Health Vol. 10(2):189-194, Feb. 1965. (Presented at the Seventh Annual Air Pollution Medical Research Conference, Los Angeles, Calif., Feb. 10-11, 1964.)

Pretreatment of oat coleopile sections with fluoride, ozone, or PAN under conditions which inhibit potential growth 50% or less results in more or less similar inhibitory responses in metabolism of the cell wall. Metabolism of cellulose and of glucan components of the more soluble hemicelluloses is inhibited more than is metabolsim of other cell wall components. (Author summary)

00737

J.T. Middleton, L.O. Emik, O.C. Taylor

AIR QUALITY CRITERIA AND STANDARDS FOR AGRICULTURE. J. Air Pollution Contorl Assoc., 18(10):476-480, Oct. 1965. (Presented at the 58th Annual Meeting, Air Pollution Control Association, Toronto, Canada, June 20-24, 19659)

Air pollution damage to crops is not only important for the damage it causes agriculture but because vegetation damage is a harbinger of air pollution problems affecting man and his well-being. Some of the effects of varying dosages of ethylene, fluoride, ozone, PAN, and sulfur oxides on plants and animals are given. Knowledge of the response of certain plants and animals to specific air pollutants permits the establishment of air quality standards for certain of these pollutants. The importance of environmental conditions on host responses to these several toxicants is also presented to illustrate the need of stipulating environmental conditions as well as toxicant dosages when establishing air quality criteria and standards for the protection of the agricultural resource.

00788

C.-J. Lee, G.W. Miller, G.W. Welkie

THE EFFECTS OF HYDROGEN FLUORIDE AND WOUNDING ON RESPIRATORY ENZYMES IN SOYBEAN LEAVES. Intern. J. Air Water Pollution (London) Vol. 10, 169-181, 1966.

Soybeans were cultured in Hoagland's solution and fumigated with hydrogen fluoride (ca 100 ppb). After 24, 96 and 144 hr of fumigation, the enzyme activities of cytochrome oxidase, peroxi- dase, catalase, polyphenol oxiddase, ascorbic acid oxidase and glucose-6-phosphate dehydrogenase were assayed in leaves from fumigated and control plants. The total oxygen uptake after each time of treatment was measured. The effect of mechanically wounding the tissue on the above enzymes was determined by rubbing with carborundum. Glucose-6-phosphate dehydrogenase activity from fumigated leaves showed an average increase of 5 to 22 times that of the control. Cytochrome oxidase, peroxidase and catalase activities were markedly stimulated by fluoric.e fumigation period. Ascorbic acid oxidase was stimulated at the initial state, then showed a steady decrease in activity. In vitro tests revealed that ascorbic acid oxidase and peroxidase were very sensitive to fluoride ions. Polyphenol oxidase was only slightly inhibited by 10 to the minus 2M KF solution. Cytochrome oxidase and catalase were not affected by KF up to 10 to the minus 2M. Total respiration throughout the treatment period showed an accelerated rate. All enzymes studied were stimulated by wounding. The effect of HF on respiration and specific enzymes is discussed in terms of direct effects and injury. (Author abstract)

00920

D. C. McCune, L. H. Weinstein, J. S. Jacobson, and A. E. Hitchcock

SOME EFFECTS OF ATMOSPHERIC FLUORIDE ON PLANT METABOLISM. J. Air Pollution Control Assoc. 14(11):465-468, Nov. 1964. (Presented at the 85th Annual Meeting, Air Pollution Control Association, Houston, Tex., June 21-25, 1964.)

Leaves of Tendergreen bean plants exposed to atmospheric fluoride concentrations in the range 1.7 to 7.6 cubic meter showed increased levels of enolase activity and decreased levels of pyruvate and a-ketoglutarate. Phosphoenolpyruvate carboxylase activity and oxalacetate were not affected. The leaves of Milo maize plants exposed to 5.0 cubic F meter showed increased levels of enolase and pyruvate kinase activity and a decreased level of pyruvate. Oxalacetate and a-ketoglutatate levels were not affected. Catalase activity was increased, then decreased by HF fumigation. The changes induced by HF were greatest six to 10 days after the start of fumigation and disappeared or decreased in magnitude during the post-fumigation period. (Author abstract)

00944

J. W. Suttie

EFFECTS OF INORGANIC FLUORIDES ON ANIMALS. J. Air Pollution Control Assoc., 14(11):461-464, Nov. 1964. (Presented at the 57th Annual Meeting, Air Pollution Control Association, Houston, Tex., June 21-24, 1964.)

Fluoride toxicity in cattle can result from the ingestion of forage contaminated by various industrial processes. The disease is recognizable through its effects on the developing bones and teeth, by chemical analysis of urine and tissues and in advanced stages by definite physiologic disturbances. Definite effects on the well-being of cattle have been found to be associated with levels of fluoride in the compact bone in excess of 5,500 ppm, and marginal bones of from 4,500-5,500 ppm. The concentration of fluoride on forage which would be needed to produce these concentrations in the skeleton would depend on a large number of factors. Air quality standards based on atmospheric fluoride levels do not seem feasible as a means of protecting livestock from possible damage. It does however appear that guidelines based on atmospheric fluoride levels or urinary fluoride content might serve to protect livestock in a community and be acceptable to fluoride emitting industries. (Author summary)

00964

L. H. Weinstein, R. H. Mandl, D. C. McCune, J. S. Jacobson, and A. E. Hitchcock

SEMI-AUTOMATED ANALYSIS OF FLUORIDE IN BIOLOGICAL MATERIALS. J. Air Pollution Control Assoc. 15(5):222-225, May 1965.

A semi-automated method for determination of fluorine in biological materials has been developed incorporating the Technicon AutoAnalyzer. One-half gram of dried, ground plant material is ashed, alkali-fused, diluted with water, and the suspension is pumped, along with H_2SO_4, at controlled rates, into the hot revolving glass helix of a digestor unit. As the acid-digest mixture passes through the heated coil, volatile fluoride and water vapor are evolved. The volatile fluoride and water vapor are pulled from the helix under reduced pressure through a tube which projects into the helix. The tube, in turn, is connected to a water-jacketed condenser and then to an impinger where the sample is continuously mixed. An aliquot of the impinger liquid is being constantly withdrawn. This sam-

ple is then air-segmented and mixed with a reagent containing alizarin complexone, pH 4 acetate buffer, lanthanum nitrate, acetone, and water. The sample-reagent combination passes through 4 full-length mixing coils where color development takes place. Upon reacting with fluoride, the wine-red alizarin complexone-La(III) reagent forms a lilac blue fluorine complex. The solution is pumped from the mixing coils through the tubular flow cell of the colorimeter. The absorbence of the solution is measured at 624 millimicrons, and the signal is transmitted to a recorder where the results are plotted on absorbency paper. The absorbence at the apex of the peak is proportional to the amount of fluoride in the sample between the range of 2.5-80 micrograms F. Samples are analyzed at a rate of 12 per hour. Results compare favorably with those obtained by Willard-Winter distillation. Recent studies indicate that the F content of plant tissues can be estimated without prior ashing and fusion. (Author abstract)

00979

D.C. McCune, A.E. Hitchcock, L.H. Weinstein

EFFECT OF MINERAL NUTRITION ON THE GROWTH AND HF SENSITIVITY OF GLADIOLUS. Contrib. Boyce Thompson Inst., Vol. 23:295-299, 1966.

The response of a given plant species to atmospheric fluorides can be affected by many factors. Some of these factors reside in the plant and others in the plant's environment. The availability of mineral nutrients may be one of the environmental factors affecting the HF sensitivity of the plant. In beans (Phaseolus vulgaris L.) exposed to acute HF fumigations, foliar fluorosis symptoms were found only in plants grown on a nitrate deficient medium although the tissue fluoride levels were equal to or less than those of plants grown in other nutrient media and exposed to the same HF concentrations. The ocygen uptake of bean seedlings and the effect of HF fumigation upon it are altered by N, P, K, Ca, or Fe deficiency. In other studies, however, nutrient excess, as well as nutrient deficiency of N, P, or Ca, was associated with decreased fluoride accumulation and injury in HF-fumigated tomatoes. These apparent contradictions as to the effect of nutrient stress may be due to apparent contradictions as to the effect of nutrient stress may be due to the use of different fumigation regimes, different experimental procedures, and plants of different species and ages. Experiments are reported which were carried out to provide more information on the relationship of nutrient stress to HF sensitivity and the nature of factors that may determine this relationship. (Author introduction)

01092

J. L. Shupe, M. L. Miner, and D. A. Greenwood

CLINICAL AND PATHOLOGICAL ASPECTS OF FLUORINE TOXICOSIS IN CATTLE. Ann. N.Y. Acad. Sci. 3, 618-37, Apr. 24, 1964. Also published in J. Oral Therap. Pharmacol. 2(4):315, Jan. 1966.

Continued ingestion by cattle of forage containing fluorides at a toxic level, coupled with the cumulative action of fluorine in the animal body may cause chronic fluorine toxicosis. This has become an important toxicologic problem in some areas of the United States and other countries. Airborne contamination of vegetation, soil, and water in feeding sections near certain fluoride-emitting industries makes the occurrence of such illness in cattle a part of the overall air pollution problem as well. Clinical and pathological data, developed from long-range experiments in Utah, correlated with extensive field and necropsy studies, are presented and analyzed in this paper. The experiments, previously reported in detail, had four objectives: (1) determination of how much fluorine could be tolerated when fed with a normal grain mixture to dairy animals from 3 months to 7 1/2 years in age; (2) influence on the cow's body processes of various levels of fluorine through a life span; (3) comparison of toxicities of various types of fluorides; and (4) study and evaluation of the use of allevintors in preventing fluorosis. Effects on the teeth, bones (especially ribs), urine, milk production, hair and skin, soft tissues, blood, placental transfer, and reproduction are discussed. The authors concluded that: 'The diagnosis, prevention, and control of fluorosis in livestock can be achieved, but only when the complexity of the disease is realized and the pathogenesis, symptomatology, and lesions are properly correlated, interpreted, and evaluated.'

01250

M. Threshow

EVALUATION OF VEGETATION INJURY AS AN AIR POLLUTION CRITERION. J. Air Pollution Control Assoc. 15, (6) 266-9, June 1965.

Foliar markings on vegetation have proven a highly sensitive criterion for the presence of many air pollutants; proper evaluation of such effects can serve as a valuable and inexpensive tool for delineating an air pollution condition. Injury symptoms from fluoride, sulfur dioxide, photochemical oxidants and other pollutants have been described and can be recognized by experienced observers. Several factors must be considered in appraising injury. These include a knowledge of the relative sensitivity of plant species to various pollutants, the syndrome of injury on a number of plants and species, and distribution and geographic relation of affected plants to the suspected source. Background information on cultural, environmental, disease and insect conditions which might be responsible for, or modify, foliar markings or chronic effects in question must also be understood. For some pollutants a chemical analysis of foliage and air may prove helpful. When these factors are studied, the presence, distribution and magnitude of an air pollution situation can be evaluated, thus providing a sensitive criterion of air quality. (Author abstract modified)

01398

G.H. Hepting

AIR POLLUTION IMPACTS TO SOME IMPORTANT SPECIES OF PINE. J. Air Pollution Control Assoc., 16(2):63-65, Feb. 1966.

In the past, many species of pine have been severely damaged by acute forms of air pollution associated with ore smelting. More recently, damage to ponderosa pine in the State of Washington has been associated with atmospheric fluoride, and this species in particular has also suffered smog damage in southern California. In the East, whie pine has been declining in the vicinity of certain soft-coal-burning power plants, and in one case downwind from an oil-burning power plant; also, throughout the East, an atmospheric oxidant of unknown source has caused a type of needle blight on white pine. Trash burners and city dump combustion have led to the killing of certain pine species, leaving other intermixed pine species unharmed. Localized damage to white pine from automobile exhaust has been observed. Differences in the susceptibility of neighboring trees of the same species to a given air pollutant have been observed repeatedly. (Author abstract)

01506

J. S. Jacobson, L. H. Weinstein, D. C. Mc Cune, and A. E. Hitchcock

THE ACCUMUL ION OF FLUORINE BY PLANTS. J. Air Pollution Control . oc. 16 (8) 412-417, Aug. 1966.

The accumulation and distribution of fluorine in plant leaves and the response of plants to concentrations of atmospheric fluoride similar to those in urban or industrial areas were studied. Chlorosis, necrosis, or growth suppression of leaves of sensitive plants may be induced by extended exposure to atmospheric fluoride concentrations of 0.6 microgram/cubic meter. In other air pollutants higher concentrations are required for injury to occur. The results indicate that at least 3 factors determining the response of plants to atmospheric F are the location of F. surface o. interior, translocation of F to tips and margins, and the degree of interchange of F between the interior and exterior of a leaf.

01557

M. J. Bossavy

CANKERS CAUSED BY FLUORINE). (LES NECROSES DUES AU FLUOR.) Pollut. Atmos. (Paris), 8(30):176-184, June 1966.

The shape, color and evolution of cankers caused by fluorine, according to the stage of development reached by the leaf for a certain number of leafy and resinous plants are described. Cankers caused by fluorine may be confused with the effects of cold, dryness or insect attacks, and very close observation is needed to avoid such confusion. Pen drawings showing differences between cankered parts and healthy parts are included. (Author summary)

01664

C.W. Chang C.R. Thompson

SITE OF FLUORIDE ACCUMULATION IN NAVEL ORANGE LEAVES. Plant Physiol. 41, (2) 211-3, Feb. 1966

Fluoride-polluted navel orange leaves, Citrus sinensis (Linn.) Osbeck, were fractionated into the subcellular components in hexane carbon tetrachloride mixtures having various densities. Fluoride was determined at each fraction. Analyses were also made for the subcellar distribution of chlorophyll, nitrogen, and DNA to assess the extent of cross-contamination of each component. The fraction containing cell wall, nuclei, and partly broken cells apparently contained a major amount of fluoride. However, if allowance was made for the cross- contamination of chloroplast and chloroplast fragments, the fraction of chloroplasts was found to be the site of the highest fluoride accumulation. When each particulate component was washed with water after drying, the combined washings contained more than 50% of the total fluoride of the isolated fractions. The usual method of fluoride accumulation from the fraction of chloroplasts to that of the supernatant. (Author summary)

01705

S. S. Woltz

DISTINCTIVE EFFECTS OF ROOT VERSUS LEAF ACQUIRED FLUORIDES. Proc. Florida State Hort. Soc. 77, 516-7, 1964. (Meeting was held in Miami, Fla., Nov. 3-6, 1964.)

In connection with studies of the effects of fluoride air pollution on plant growth, the question arises as to whether soil-borne fluorides may contribute significantly to the fluoride content of plants and thus add to the toxicity of airborne fluorides. After extensive research, MacIntire and others concluded that with normal agricultural soils of low acidity, fluoride uptake by the roots does not occur to any significant degree. The experiments to be reported were carried out to determine the applicability of these conclusions to Florida conditions and to determine whether the effects of soil fluorides could be distinguished from those of atmospheric fluorides.

01800

R.H. Daines, I.A. Leone, E. Brennan

AIR POLLUTION AS IT AFFECTS AGRICULTURE IN NEW JERSEY. Rutgers - The The State Univ., New Brunswick, N.J., Agricultural Experiment Station. (Bulletin 794).

Plant damage in New Jersey from sulfur dioxide, hydrogen fluoride, herbicides, ozone, and from oxidants other than ozone is discussed. Relevant literature is reviewed.

01809

J.T. Middleton

TRENDS IN AIR POLLUTION DAMAGE. Arch. Environ. Health 8, 19-23, Jan. 1964. (Presented at the Sixth Annual Air Pollution Medical Research Conference, San Francisco, Calif., Jan. 28-29, 1963.)

Plant damage from particulates, oxidants, ozone, ethylene, fluoride and sulfur dioxide are discussed. The trends in California are emphasized. The relevant literature is reviewed.

02041

L. de Cormis

(COMPARISON OF THE ACTIONS OF SULPHUR DIOXIDE AND FLUORINE COMPOUNDS ON SOME PLANTS.) Action Comparee de l' Anhydride Sulfureux et des Derive Fluores Sur Quelques Vegetaux. Proc. (Part I) Intern. Clean Air Cong., London, 1966. (Paper VI/5. pp. 173-3.

Sulphur dioxide and fluorine compounds are well-known polluting agents. In many industrial areas in France they are the cause of appreciable damage to the surrounding vegetation. The appearance and the morphology of the burns vary according to the polluting agent involved; moreover, the climatic conditions have a preponderating influence on the extent of the damage observed. The absorption rates of the two polluting agents have been studied and there is an important difference between the two gaseous pollutants. After having been absorbed, sulphur dioxide and the fluorine compounds behave differently in the plant. This may be explained by the fact that sulphur is a normal metabolite of the plant, whereas the fluorine ion is irrelevant to it and does not therefore take part in any normal metabolic process. It accumulates in certain definite parts where it could cause necroses when a certain level has been overstepped. (Author abstract)

02049

J. Bossavy

(THE ACTION OF GASEOUS FLUORINE COMPOUNDS ON FOREST SPECIES.) Action des Fluorures Gazeux Sur les Especes Forestieres. Proc. (Part I) Intern. Clean Air Cong., London, 1966. (Paper VI/13). pp. 193-6.

Very close study of vegetation makes it possible to reduce a pollution by examining only the canker or burning which this examination shows occurs on the vegetation around the station- herbaceous flowers, shrubs and trees. The time at which such a programme should start must be judiciously decided. The possibility of proceeding with sampling and analysis of leaves or (pine) needles remains. It appears that in the USA the tendency is to establish a single pollution by chemical anal-

ysis of the air which, incidentally, does not provide information on the damage caused to plants and animals. In the USSR, on the contrary, Dr. Izmerov takes examination of vegetations as the basis for determining air quality. The author thinks that this latest type of study requires sustained attention, and sense of observation, extensive knowledge of vegetable biology, and of the kinds of attack to which various vegetable forms are liable. It makes it possible to place diagnosis of pollution-by fluorine (compounds) on firm basis. (Author abstract)

02200

M.R. Pack

RESPONSE OF TOMATO FRUITING TO HYDROGEN FLUORIDE AS INFLUENCED BY CALCIUM NUTRITION. J. Air Pollution Control Assoc. 16, (10) 541-4, Oct. 1966.

An investigation of the response of tomato fruiting to atmospheric HF and the influence of calcium nutrition is described. Two varieties of tomatoes grown at 40-200 ppm. calcium were continuously fumigated with HF throughout flowering and fruit development. Fluoride injury to the tomato foliage was most severe at the lowest calcium level. Treatment with HF about 3 micrograms g.F/cu m produced some injury to tomato foliage but had no apparent effect on fruiting. The relationship between fluoride injury and calcium nutrition suggests interference with calcium metabolism as a mechanism of fluoride injury to plants.

02379

C. R. Thompson.

THE TOTAL EFFECT OF AIR POLLUTANTS ON BEARING CITRUS. Preprint. 1965.

The three field installations of plastic covered greenhouse established over bearing lemon and orange trees will be continued for one, two and three years, respectively, until five years of data are obtained at each installation on the effects of air pollutants on fruit yield, leaf drop, fruit quality and storage stability of fruit. More refined measurements of the more basic responses of the trees, apparent photosynthesis, respiration and transpiration will be made and correlated with the occurrence of specific pollutants in the air. The way in which oxidants cause increased leaf drop will be studied. The effects of very low levels of fluoride on trees will be investigated to find out whether or not there may be a significant stimulation of the above mentioned responses, especially fruit yield. The effect of nitrogen dioxide will be examined in the fractions of one part per million range. Interrelationships between the presence of air pollutants and beneficial or deleterious insects will be examined. An attempt will be made to determine threshold levels of pollutants below which no injury occurs to plants. A concerted effort will be made to overcome the excessive fruit abortion of navel oranges by the application of antioxidants. Results of some of the studies in the following categories are reported: photosynthesis; fruit yield, transpiration; leaf carbohydrate levels; anthrone reducing carbohydrates in citrus leaves; leaf drop. (Author summary modified)

02382

L. H. Weinstein, P. Preuss, D. C. Mccune, J. S. Jacobson, D. C. MacLean, and A. I. Lemmens.

METABOLISM OF 2-(C-14)-FLUOROACETATE BY HIGHER PLANTS. Preprint. 1965.

In recent years several plants have been shown to have the capacity to biosynthesize fluoro-organic compounds from inorganic fluorides. Several species of Dichapetalum have been shown to be somewhat toxic to animals and to induce increased levels of citric acid in kidney and brain tissues of mammlas, a condition induced by fluoracetate poisoning. The experiments described in this paper were carried out to study the metabolism of 2-14C-fluoroacetate in seedlings of Acacia, peanut, castor bean, and Pinto bean, the synthesis of fluoroacetate from NaF in Acacia, and to develop analytical methods for microgram amounts of fluoroacetate and other fluoro-organic compounds.

02516

Lovelace, J., G. W. Miller, and G. W. Welkie

THE ACCUMULATION OF FLUOROACETATE AND FLUOROCITRATE IN FORAGE CROPS COLLECTED NEAR A PHOSPHATE PLANT. Atmos. Environ., Vol. 2, p. 187-190, 1968. 10 refs.

Plants were collected from an area high in atmospheric fluoride. Animals grazing on this area showed severe fluoride injury. Analyses of plants indicated accumulation of fluorocitrate and fluoroacetate at concentrations of 896 micrograms and 179 micrograms per gram leaf dry wt. The presence of these compounds was established by chromatographic techniques, inhibition of aconitase and i.r. spectral analysis. (Authors' abstract)

02537

G. Seidman

EFFECTS OF AIR POLLUTION ON PLANTS. African Violet Mag. 18, (3) 44-7, Mar. 1965

The first indication of an air pollution problem is often the injury that appears on comparatively sensitive vegetation. Some plants are more resistant than others to a given phytotoxicant. Plant injury from air pollution is caused primarily by the major gaseous pollutants (sulfur dioxide, fluoride gases, ethylene, and the components of the photochemical smog complex) and is produced in various ways in urban or industrial areas. These major pollutants and several of the minor pollutants are discussed in this paper.

03116

G. Tendron

EFFECTS OF AIR POLLUTION ON ANIMALS AND PLANTS. European Conf. on Air Pollution, Strasbourg, 1964. pp. 25-69.

There is no doubt as to the effects of air pollution on plants and animals, particularly in the case of a few specific and very dangerous pollutants which are emitted in considerable quantities. In certain regions of Europe, life depends on immediate steps being taken to protect flora and fauna. There is no doubt that they will need to be mainly of a technical nature. It is a matter of reducing the discharge of polluted waste and attenuating, if not completely eliminating, the dangers involved. The necessary technical research must be organised in such a way as to cover all the different aspects of animal and plant life, the safety of which is indissolubly bound up with that of human life. In the Netherlands, a team of workers succeeded in arresting the devastation of horticultural crops by fluorine emissions thanks to the use, during the period of growth, of a raw material which when processed did not give off toxic fumes. In France, the Association for the Prevention of Air Pollution has set up a study group known as the 'Committee for studying the effects of air pollution on cultivated plants and animals' to standardise working methods throughout the country. Mention should also be made of the Norwegian and

British studies of the preventive effects of various fluorine alleviators and the research being done in the Federal Republic of Germany on the stimulation of plant nutrition by industrial emissions, as well as on countering the effects of such emissions by the addition of fertilisers. These few achievements show the importance of rational organisation and cooperation in research.

03360

C. W. Chang and C. R. Thompson

EFFECT OF FLUORINE ON NUCLEIC ACIDS AND GROWTH IN GERMINATING CORN SEEDLING ROOTS. Physiol. Plantarum 19, 911-8, 1966.

Corn seeds were treated with 0.01 M sodium fluoride for various time periods. The treated seeds were germinated and grown until the seedling roots reached a standard size of 12 plus/minus 3 mm. Analyses were made for RNA and DNA contents of 3-mm seedling root tips. Determinations also were made for growth rate, rate of cell elongation, cell multiplication, and tissue maturity of 12-mm roots. RNA contents of 3-mm root tips were found to be directly proportional to the growth rates of the entire seedling root of corn seeds treated with sodium fluoride for various periods of time. The RNA content was reduced on a cell basis and was independent of the root tip cell number. The amount of DNA was not related to the growth rate of the intact seedling roots. Since fluoride reduced the number of mitotic multiplication not more than about 40 per cent of the control figures, it was likely that fluoride inhibited DNA synthesis during the interphase of the mitotic cycle. Growth by cell multiplication was inhibited more than that by cell elongation in the sample treated with fluoride for a shorter period. The two types of growth, however, showed a similar level of growth reduction in the sample treated with fluoride for a longer period. Fluoride seemed to reduce the rates of cellular elongation and value in these tissues under present experimental conditions. Fluoride also induced maturity in the seedling roots in proportion to the periods of fluoride treatment. (Author abstract)

03395

M.D. Thomas

EFFECTS OF AIR POLLUTION ON PLANTS. World Health Organ. Monograph Ser. 46 (Air Pollution), 1961. pp. 233-78.

The literature on the effects of air pollution on plants has been reviewed with special reference to those pollutants that present major problems - viz., SO2, HF, London type smog, and Los Angeles type smog. The others, which are definitely of minor importance, are referred to more briefly. SO2 has long been recognized as an air pollutant because it arises from the combustion of nearly all fuels, especially coal, and from the roasting of sulfide ores. It is phytotoxic in concentrations above 0.1 x 0.2 p.p.m., depending on the length of exposure. Below about 0.4 p.p.m., the gas tends to be oxidized in the cells as rapidly as it is absorbed, and interference with functions such as photosynthesis is slight. Toxic concentrations of sulfate are finally accumulated. Chronic rather than acute injury, if any, is generally manifested with these small concentrations. Above about 0.4 p.p.m., acute injury occurs more frequently, owing to the reducing properties of sulfate in the cells. Temporary interference with photosynthesis or 'invisible injury' can occur to some extent, but these concentrations cause acute injury if maintained for more than short periods, and recovery is rapid when the fumigation is stopped. HF behaves somewhat similarly to SO2, except that with a few species of plants it is effective in causing lesions and interfering with photosynthesis in concentrations 2 or 3 orders of magnitude smaller than in the case of SO2. With most species it is up to 10 times as effective as SO2. Fluoride accumulated in the cells in sublethal amounts interferes with photosynthesis as does sulfite, but whereas the latter is deactivated by simple oxidation to sulfate, the former must be removed by translocation, volatilization, or some obscure chemical reaction, which makes much slower the recovery of the plant functions after HF fumigation. There appears to be a concentration of HF for each species below which 'invisible injury' does not occur. The Los Angeles type smog is fairly well understood as to its mode of formation and its phytotoxic effects, but the actual compounds that cause these effects are still unknown. The smog causes characteristic leaf lesions which are quite different from those produced by other pollutants, including ozone, which may be a constituent of the smog. It also causes some 'invisible' injury. Visible damage to crops in Southern and Northern California was estimated at over $5 000 000 and $1 100 000 respectively, annually, in 1956. (Author summary modified)

03472

C. S. Brandt

AIR POLLUTION EVVECTS ON VEGETATION. Conn. Med. 27, (8) 484-6, Aug. 1963.

The effects of air pollution particularly of sulfur dioxide, fluorides and photochemical smog on plants are briefly reviewed. The characteristic symptoms of air pollution injury to plants can be useful tool in field surveys. Great care must be exercised in using plants as indicators of air pollution, because many factors affect the symptoms, development, and interpretation of plant indicators.

03549

D. F. Adams

AN AIR POLLUTION PHYTOTRON (A CONTROLLED ENVIRONMENT FACILITY FOR STUDIES INTO THE EFFECTS OF AIR POLLUTANTS ON VEGETATION). J. Air Pollution control Assoc. 11, (10) 470-6, Oct. 1961. (Presentrd at the 54th Annual Meeting, Air Pollution Control Association, New York City, June 11-15, 1961.)

The facilities described have been used in the study of the influence of atmospheric fluoride pollution on plant response. The design concepts and resultant equipment are equally applicable to similar plant studies using other atmospheric pollutants. Only relatively minor changes in the atmosphere-producing equipment would be required. So-called field conditions cannot be produced in a phytotron chamber since the objective is one of a completely controlled plant environment. However, numerous parameters such as (a) stem elongation and diameter, (b) leaf size and development, (c) chlorophyll, sugar, carbohydrate, and enzyme content, and (d) respiration and photosynthetic rates, etc., readily respond to all phases of the plant environment and thus introduce difficulties in separating the response to these variables from that of the air pollutant. Thus the availability of such an air pollution phytotron promises to eliminate much of the present uncertainty involved in relating physiological and biochemical measurements with air pollution.

03570

G. G. Applegate, D. F. Adams, and R. C. Carriker.

EFFECT OF AQUEOUS FLUORIDE SOLUTIONS OF RESPIRATION OF INTACT BUSH BEAN SEEDLINGS. I. INHIBITION AND STIMULATION OF OCYGEN UPTAKE. Am. J. Botany 47, (5) 339-45, May 1960.

Intact bush bean seedlings were infiltrated with 1 x 10 to the minus 1, 1 x 10 to the minus 2, 1 x 10 to the minus 3, and 1 x 10 to the minus 4 M fluoride. A linear relationship was found to exist between the fluoride concentrations of the infiltrating solutions and tissue fluoride. The higher fluoride concentrations inhibited oxygen uptake, whereas lower fluoride concentrations accelerated oxygen uptake. Both inhibition and acceleration of oxygen uptake by fluoride were modified by light, CO2, and presence or absence of chlorophyll. (Author abstract)

03571

H. G. Applegate and D. F. Adams.

EFFECT OF ATMOSPHERIC FLUORIDE ON RESPIRATION OF BUSH BEANS. Botan. Gaz. 121, (4) 223-7, June 1960.

The oxygen uptake in bush-bean plants is accelerated when the plants are exposed to atmospheric fluoride at concentration levels below those inducing visible foliar symptoms of fluorosis. Under the environmental conditions used in this experiment, fluoride uptake of bean plants given a 24-hour fumigation just prior to the day of sampling was relatively constant from the eighth to the twentieth days of growth. Similar plants fumigated continuously from planting until harvest showed steadily increasing amounts of tissue fluoride because of the greater duration of exposure. Under the 24-hour fumigation the daily rate of fluoride accumulation tended to increase until after the plants had emerged and then remained relatively constant; under continuous fumigation the rate tended to increase throughout. (Author summary)

03572

H. G. Applegate and D. F. Adams.

'INVISIBLE INJURY' OF BUSH BEANS BY ATMOSPHERIC AND AQUEOUS FLUORIDES. Intern. J. Air Water Pollution 3, (4) 231-48, 1960. (Presented at the Annual Meeting, American Society of Plant Physiologists, San Diego, Calif., June 17, 1959.)

Bush beans, Phaseolus vulgaris var. humilis, when subjected to either gaseous fluoride or solutions containing fluoride, have abnormal oxygen uptake when compared with similar plants not subjected to fluoride. Plants given gaseous fluoride for 24 hours prior to harvest consistently had greater oxygen uptake than their control counterparts. Plants given continuous fluoride from time of germination had, with the exception of a short period around the fifth day, greater oxygen uptake than their control plants. Between the fourth and sixth days, continuously fumigated plants had a lower oxygen uptake than the unfumigated control plants. There appeared to be little difference in respiration patterns between gaseous fluoride-mediated respiration and aqueous fluoride-mediated respiration. This physiological disturbance induced by fluoride which has been demonstrated is considered to be an example of 'invisible injury', by classical definition. (Author abstract)

03611

J. T. Middleton

CLEAN AIR FOR GOOD CITRUS. Western Citrus Grower 1(6):6-9, June 1958. (Found in Western Fruit Grower 12, (6), June 1958.)

The adverse effects of polluted air on citrus crops are reviewed. Included in the discussion are the effects of sulfur dioxide, ozone, oxidants and fluorides. It is concluded that abatement measures must be taken to protect agricultural areas.

03612

J. T. Middleton, E. F. Darley, R. F. Brewer

DAMAGE TO VEGETATION FROM POLLUTED ATMOSPHERES. J. Air Pollution Control Assoc. 8, 9-15, May 1958. (Presented at the 22nd Midyear Meeting, American Petroleum Inst. Division of Refining, Philadelphia, Pa., May 14, 1957.)

Damage to vegetation from polluted atmospheres has been recognized for more than a century. Early interest in air pollution centered largely on smoke and fumes from industrial wastes, particularly those of chemical manufacture, smelting, ceramic production, and coal and petroleum conbustion effluents. Vegetation damage has increased with industrialization and urban development. Whereas the principal plant toxicants recognized several decades ago were sulfur dioxide and fluorine, in the last decade a new group of airborne phytotoxicants has been described and identified as oxidants. The principal source of these oxidants is believed to be photolysis reaction products of auto exhaust. Atmospheric contaminants responsible for damage to vegetation may be described as particulates - such as dusts and acid aerosols - and gases - such as sulfur dioxide, halogens, oxidized organics, ozone, nitrogen dioxide, hydrogen sulfide, ammonia, and carbon monoxide. Of these diverse pollutants, gases generally cause more damage to plants than do particulates.

03613

J. T. Middleton A. O. Paulus

THE IDENTIFICATION AND DISTRIBUTION OF AIR POLLUTANTS THROUGH PLANT RESPONSE. A.M.A. Arch. Ind. Health 14, 526-32, Dec. 1956. (Taken from a paper presented at the 17th Annual Meeting, American Industrial Hygiene Association, Philadelphia, Pa., Apr. 23-27, 1956.)

This paper presents an annual summary of monthly tabulations showing plant damage occurring in 12 of 51 counties. Regional tabulations show that plant damage is limited to the San Francisco Bay area and the coastal plain of southern California. The areas reporting plant damage are those of greatest population density. The toxicants responsible for plant damage are recognized in decreasing order of importance as oxidized hydrocarbons, ethylene and fluorides. Sulfur dioxide is of unusual occurrence and its distribution usually associated with specific industrial wastes. It is generally believed that ozone is present in the urban areas of Los Angeles and San Francisco and responsible for a significant part of the total atmospheric pollution. The wide-spread distribution of ethylene and smog, or reaction products from the oxidation of hydrocarons, emphasizes the need for regional, research and abatement programs.

03616

J. T. Middleton, A. S. Crafts, R. F. Brewer, O. C. Taylor

PLANT DAMAGE BY AIR POLLUTION. Calif. Agr. 9-12, June 1956.

In many of the important growing areas of California the production and quality of vegetables and crops are adversely affected by air-borne toxicants such as ethylene, fluorides, herbicides, oxidized hydrocarbons, ozone and sulfur dioxide. Injury to plants by oxidized hydrocarbons (smog) is distinctly different from crop damage by the other above named precursors. Leaves of celery, lettuce, spinach, and some other vegetables, and of flower crops and African violets usually show silvering and glazing on their lower surfaces, sometimes followed by a bronze or reddish discoloration. Examples of the plant damage are shown in color photographs. Visivle inju-

ry to all crops in the Los Angeles areas has caused losses exceeding $3,000,000 annually since 1953. This does not include economic losses from reduced growth and lowered production in the absence of visible injury.

03629

03629 G. W. Todd

PHYSIOLOGICAL RESPONSES OF PLANTS TO AIR POLLUTANTS. J. Appl. Nutr. 10, 456-8, 1957. (Presented at the 20th Annual National Convention, American Academy of Nutrition, Los Angeles, Calif., 1956.)

The mechanisms whereby plants are damaged and the various ways in which they may show manifestations after fumigation by air pollutants are reviewed. The discussion is primarily concerned with the effects of ozone, ozonated unsaturated hydrocarbons, naturally-occurring air pollutants in the Los Angeles basin, and to a small extent hydrogen fluoride.

03676

G. H. Hepting and C. R. Berry

DIFFERENTIATING NEEDLE BLIGHTS OF WHITE PINE IN THE INTERPRETATION OF FUME DAMAGE. Intern. J. Air Water Pollution 4(1/2): 101-105, 1961. (Presented at 3rd National Air Pollution Seminar, New Orleans, La., Mar. 23, 1960.)

Because of chronic blighting of the foliage of white pine in recent years in east Tennessee, the U.S. Forest Service and TVA have renewed investigation of the white pine blight complex. The eastern white pine is subject to an unusually large assortment of maladies, which could be and have been confused with fume damage. It has proven to be difficult to assess the possible role of air pollution in such cases unless one can clearly differentiate the symptoms of fume damage from those of other troubles that so often occur in the same areas. White pine eastern and western are regarded sensitive to such pollutants as sulfur dioxide and fluoride. One of the primary objectives has been to learn how to distinguish and separate the needle troubles occurring on white pine in the southeast that can now be attributed to a pathogen. Three that can be recognized as distinct entities are discussed in this paper: Emergence tipburn, post-emergence acute tipburn, and post-emergence chronic tipburn.

03729

A. H. Mohamed, J. D. Smith, H. G. Applegate

CYTOLOGICAL EFFECTS OF HYDROGEN FLUORIDE ON TOMATO CHROMOSOMES. Can. J. Genet. Cytol. 8, (3) 575-83, Sept. 1966.

Study was undertaken to determine if hydrogen fluoride caused any cytogenetic effects on tomato plants at a concentration too low to induce visible injury. Also, preliminary studies on plants of the C1 generation showed abnormal phenotypes indicating that hydrogen fluoride has the ability to change directly or indirectly the normal pattern of development. It was concluded that hydrogen fluoride may be considered to have a mutagenic action on tomato chromosomes.

03766

Merrill, Malcolm H.

RECEPTOR EFFECTS OF AIR POLLUTION. American Meteorological Society, Boston, Mass., Committee on Air Pollution, Interdisciplinary Conf. Atmos. Pollut., Santa Barbara, Calif., 1959, p. 1-6. 10 refs. (June.)

Some harmful effects of air pollutants on man and plants are described. There is a positive relationship between air pollution and emphysema and bronchitis. The lung function of patients with emphysema improves considerably when these patients are taken out of polluted air and placed from one to two days in a room with air passed through activated charcoal filters. Most of California plant damage is caused by a group of airborne contaminants which include ethylene, fluorides, oxidized, hydrocarbons, ozone, and sulfur dioxide. All can be identified by plant response. Ethylene is derived from chemical manufacturing processes and motor vehicle traffic. It causes poor leaf formation in some flowers, leaf irregularities and poor flower formation in others. Failure of carnation blossoms to open, flower drop in snapdragons, and withering and drying of petals of some types of orchids are attributed to the toxicity of ethylene. Prune, apricot, and peach trees are especially susceptible and can be damaged by hydrogen fluoride in concentration as low as 0.02 to 0.05 ppm. This is a problem of special concern to agriculture in the vicinity of a certain number of operations in which fluorides are emitted to the atmosphere.

03860

N. R. Benson

FLUORIDE INJURY OR SOFT SUTURE AND SPLITTING OF PEACHES. Proc. Am. Soc. Hort. Sci. 74, 184-98, Dec. 1959.

A serious disorder of peaches in which the fruit prematurely develops soft red flesh along the suture toward the apex occurred in an area (near Wenatchee, Washington) having fluoride polluted air. The symptoms were reproduced experimentally by spraying fluoride on the trees and also by subjecting the trees to an atmosphere containing water-scrubbed fumes from heated cryolite. The condition was shown to be recognizably different from furit symptoms resulting from 2,4-D or 2,4,5-T. In the polluted area, trees sprayed with lime or calcium chloride produced normal fruit. The period of retarded growth (pit hardening) was the time when lime sprays were most effective in preventing the damage. It is concluded that there is a causal relationship between the soft suture disorder and the fluoride pollution of the air. (Author summary)

03873

I. A. Leone, E. G. Brennan, R. H. Daines W. R. Robbins

SOME EFFECTS OF FLUORINE ON PEACH, TOMATO, AND BUCKWHEAT WHEN ABSORBED THROUGH THE ROOTS. Soil Sci., 66, 259-266, Dec. 1948.

The specific objectives of this experiment were to ascertain: (a) amounts of fluorine required in the substrate to produce visible injury in the plant when sodium fluoride is absorbed through the roots; (b) the length of time required for the plant to show external symptoms of fluorine injury; (c) characteristic pattern of injury produced on plant foliage as a result of fluorine absorption through the roots; and (d) the relation between the amount of fluorine in the substrate and that accumulated in the plant tissue. Concentrations of 200 and 400 p.p.m. of fluorine in the nutrient solution caused the death of peach, tomato, and buckwheat plants in a short time. At a concentration of 100 p.p.m. fluorine, peach and buckwheat were severely injured in 3 days, whereas tomato required a considerably longer time, 18 days, for symptoms to appear. At concentrations of 10, 25, and 50 p.p.m. fluorine, peach and buckwheat were moderately injured within 13 days, whereas tomato required as long as 48 days for symptoms to appear. At a concentration of 10 p.p.m. fluorine, peach leaves showed injury, but neither tomato nor buckwheat showed any foliage damage. Where actibely growing plants were involved, injury

first appeared on the tips of the younger leaves, then extended along the leaf margin and finally inward toward the midrib. In each case the injury appeared as a scorching of the affected areas; however, when injury symptoms appeared on peaches approaching the dormant stage, the youngest fully expanded leaves first showed injury in the form of marginal scorching. At the highest fluorine concentrations, necrosis was preceded by a general wilting of the plant, probably as a result of root injury. The injury in this case progressed frommthe petioles and veins outward through the leaf blades. Here again there was a bleaching of the original brown color to a buff color with time. In all three plant species, fluorine accumulation in the tissues varied with the amount of fluorine in the nutrient substrate, increasing as the fluorine concentration was increased. In every case the amount of fluorine in the leaves greatly exceeded that of the stems.

04403

R. F. Brewer, R. K. Creveling, F. B. Guillemet, and F. H. Sutherland

THE EFFECTS OF HYDROGEN FLUORIDE GAS ON SEVEN CITRUS VARIETIES. Proc. Am. Soc. Hort. Sci. 75, 236-43, 1960.

The fumigation experiment, discussed in this paper was designed to determine the effects of exposure to HF gas on growth, fluoride accumulation, and development of toxicity symptoms by 7 varieties of citrus. Trees were divided into two duplicate groups, each containing four trees of a given variety. One group was placed in a greenhouse fumigation chamber receiving air containing 10-12 ppb F as HF. The other group was placed in the duplicate control chamber which received clean, filtered air. The method of analysis for determining fluorine content of plant material was a modification of the Willard-Winter distillation procedure. Accurately rating the varieties as to their relative sensitivity is somewhat difficult, however, because of the wide variations in type as well as degree of response. If degree of chlorosis were the sole criterion, the two lemon varieties would be considered the most sensitive. On the other hand, the Valencia and navel orange would be rated more sensitive than the lemons if gross growth response (linear growth, truck diameters, and weight of tops) were the criteria used. An unexpected but significant result of these studies was the apparent evidence of so-called 'hidden injury', that is, decreased vigor and growth (growth defined here as gain in dry weight) disproportionate to the amount of leaf areas rendered photosynthetically inactive due to necrosis. This type of injury is almost impossible to diagnose in the field because it can only be recognized when one has a healthy, vigorous tree which has received fluoride-free air for comparison. Actually, the injury was not entirely 'hidden' because it was accompanied by a considerable degree of chlorosis. Unfortunately, as was pointed out previously, the chlorosis patterns varied considerably with variety, and to some extent from leaf to leaf within any given variety. This, of course, makes visual diagnosis extremely difficult and requires chemical analysis to establish the presence of toxic concentrations of fluoride in the foliage.

04544

H. E. Stokinger

EFFECT OF AIR POLLUTANTS ON WILDLIFE. Conn. Med. 27, (8) 487-92, Aug. 1963.

A review of information derived from both field and laboratory investigations of the effects of air pollutants on terrestrial animals indicates that (1) of all known air pollutants, economic poisons pose the greatest current threat to the health of wildlife. (2) Inorganic substances, (certain heavy metals and fluorides), account for limited and local injury to wildlife based on known effects on domestic animals. (3) The hazard to wildlife is chiefly from ingestion of the 'fallout' of the air pollutant. (4) Relative species susceptibility to specific air pollutants is far from clear, but it would appear that the mammals are considerably more susceptible than birds. (5) Laboratory studies have revealed three rather general phenomena associated with exposure to air pollutants: a. Synergism, the exalted or potentiated toxic effect of combination of certain air pollutants: its converse, antagonism, in which the summated toxicity is either far less than predicted or nonexistent. b. Tolerance and cross tolerance to pulmonary edema-producing agents. c. The immunochemical response.

04672

R. F. Brewer, F. H. Sutherland, F. B. Guillemet

SORPTION OF FLUORINE BY CITRUS FOLIAGE FROM EQUIVALENT SOLUTIONS OF HF, NAF, NH4F AND H2SIF6. Proc. Am. Soc. Hort. Sci. 76, 215-9, 1960.

Individual young navel orange trees were sprayed five times at two week intervals with .0004, .001,.01 and .01 N solutions of HF, NaF, NH4F and H2SiF6. CaF2 was also applied at the lowest concentration. Except at the lowest concentration, more fluoride was sorbed by citrus leaves sprayed with NaF and HF than by those sprayed with NH4F and H2SiF6. The average increments in foliar fluoride content per spraying were approximately 1.5 ppm with .0004 N solutions, 5 ppm at the .001 N level, 12 ppm at the .01 N level and 90 ppm with 0.1 N spray solutions. Differences in ion size rather than degree of ionization are suggested as being responsible for the observed differences in the amounts of fluoride sorbed by citrus leaves from equivalent solutions of the various fluoride compounds. (Author summary)

04678

A. E. Hitchcock, P. W. Zimmerman, R. R. Coe

THE EFFECT OF FLUORIDES ON MILO MAIZE (SORGHUM SP.). Contrib. Boyce Thompson Inst. 22, (4) 175-206, Dec. 1963.

Since 1951 more than 150 species and varieties of plants have been exposed to controlled dosages of fluorides in the air or soil. Gladiolus sp. and Milo maize (Sorghum sp.) were among the species most sensitive to volatile, such as hydrofluoric acid (HF) and fluosilicic acid (H2SiF6). Results for gladiolus have been summarized for the period 1951 to 1960. Snow Princess and Elizabeth the Queen gladiolus were used as indicator species in many of the experiments with Milo maize in order to compare the known differential response of the two gladiolus varieties to fluorides with the response of Milo maize. This report summarizes the results of investigations carried out during the years 1953 to 1961 relating to the effects of fluorides on the growth and development of several varieties of Sorghum spp.

04679

A. E. Hitchcock, P. W. Zimmerman, R. R. Coe

RESULTS OF TEN YEAR'S WORK (1951-1960) ON THE EFFECT OF FLUORIDES ON GLADIOLUS. Contrib. Boyce Thompson Inst. 21, (5) 303-44, Mar. 1962.

Results of the effects of fluorine (F) compounds on the growth and development of Gladiolus sp. are summarized for a period covering the decade 1951 to 1960. Tip burn and accumulation of F in control and hydrofluoric acid (HF) fumigated plants varied considerably with the variety of gladiolus, cultural site,

age of plant, and age of leaf. Control plants in the area where experimental fumigations with fluorides were carried out had more tip burn and accumulated more F than plants 0.5 to 1.3 miles distant. Gladiolus in the 5-to 7- leaf stage exhibited more tip burn and accumulated more F than plants in the 3-leaf stage. Middle-aged leaves generally exhibited the most tip burn, but the older leaves accumulated more F than the younger leaves. In general, the more resistant varieties accumulated the most F and susceptible varieties the least amount, irrespective of the flower color of the variety. Tip burn and accumulation of F were greater at higher concentrations of HF. Increase in tip burn was correlated with dosage up to 2 to 4 times the threshold level. The dosage- response curve for moderately resistant Elizabeth the Queen was significantly flatter than for the susceptible Snow Princess variety. There was a highly significant regression of tip burn on F content of leaves in both varieties. There was no relation between susceptibility and number and location of stomate. At levels of HF up to about 2 parts per billion (ppb.) of air, which caused 5 to 8 cm. of tip burn, there was no significant effect on dry weight of tops or corm yield in the varieties Snow Princess and Elizabeth the Queen, but the production of flower spikes was signicantly less in this series of experiments. There was no close correlation between length of tip burn and size of corm produced by the same plant. Within one week after exposure to HF, Now Princess had lost up to 40 to 50 per cent of the F from aboveground parts of the plant, while control plants gained in F. Elizabeth the Queen lost little (av. 10 per cent) or no F. (Authors' summary)

04683

M. C. Ledbetter, R. Mavrodineanu, A. J. Weiss

DISTRIBUTION STUDIES OF RADIOACTIVE FLUORINE-18 AND STABLE FLUORINE-19 IN TOMATO PLANTS. Contrib. Boyce Thompson Inst. 20, (5) 331-48, Mar. 1960.

A study of distribution and site of accumulation of fluorine in tomato plants was carried out using NaF-18, HF-18, NaF-19, and HF-19 applied as solutions through roots and cut vascular systems, and in gaseous form to the aerial parts. In order of decreasing concentration, the gross distribution of fluorine applied as NaF-19 through the soil was: roots, lower leaves, upper leaves, and stems. Regardless of the path of entrance of the fluorine into the plant, it was possible to wash up to 68 percent of the flourine from the leaves with distilled water and up to 83 percent with water containing a detergent. Distribution based on autoradiograms showed that most accumulation of fluorine-18 applied as JF-18 to tomato plants was at the tips and margins of leaflets and in the glands along the stem. Little fluorine-18 was found in the stems and petioles. In short-term or long-term experiments up to 80 per cent of the fluorine-18 or fluorine -19 of the leaves applied as HF was found in the stripped epidermis of Sedum spectabile Boreau. Distribution of fluorine-19 applied as HF-19 to tomato leaves after long- term accumulation was, in order of decreasing concentration: cell walls chloroplasts, soluble proteins, mitochondria, and microsomes. With short-term accumulation of fluorine-18 applied as HF-18 the order was: soluble proteins, chloroplasts, cell walls, and mitochondria. The fluorine in the chloroplasts was associated mainly with the proteinaceous substances since little or no fluorine-19 was found in the pigments and lipids. (Author summary)

04688

R. Mavrodineanu

A METHOD OF FUMIGATING PLANTS WITH HYDROFLUORIC OR HYDROFLUOSILICIC ACID USING ATOMIZATION AND THERMAL ACTION. Contrib. Boyce Thompson Inst. 18, (1) 17-20, Dec. 1954.

Equipment and procedures are described for producing nearly constant concentrations of hydrofluosilicic acid (H2SiF6) and hydrofluoric acid (HF) in fumigation cabinets ranging from less than one to several hundred parts per billion. The method makes use of diluted solutions (0.01 to 1 percent) of commercial preparations of these acids which are atomized by an air pressure of 10 to 12 lb. per sq. in. through a modified No. 15 De Vilbiss atomizer and are then passed through a low- temperature, electrically-heated tube where they are changed to the gaseous state before delivery to the air stream entering the fumigation cabinets. All equipment is of simple construction, relatively inexpensive, and has no moving parts. (Author summary)

04728

L. H. Weinstein

EFFECTS OF ATMOSPHERIC FLUORIDE ON METABOLIC CONSTITUENTS OF TOMATO AND BEAN LEAVES. Contrib. Boyce Thompson Inst. 21, (4) 215-31, Dec. 1961.

Time-course experiments were run in order to determine the effect of continuous 24-hour fumigation with hydrogen fluoride (12.4 p.p.b. v/v and 1.3 p.p.b. v/v) on the dry weight, fluoride content, and levels of free amino acids and amides, non-volatile organic acids, free sugars, ribo(RNA) and deoxyribonucleic (DNA) acids, and chlorophylls a and b in leaf tissues of Bonny Best tomato and Tendergreen bean plants. The high level of hydrogen fluoride used (12.4 p.p.b. v/v) was selected to induce maximum biochemical effects with a minimum amount of injury. Thus, no attempt was made to duplicate natural field conditions. During fumigation plants were harvested at 3-day intervals for 9 days. This was followed by a recovery period during which plants were again harvested at the same intervals. In general, it was found that during fumigation at 12.4 p.p.b. v/v there was a reduced growth of tomato leaves, although this trend was reversed by the end of the recovery period. In beans there was a small but consistent reduction in yield of leaves.

04732

P. W. Zimmerman A. E. Hitchcock

SUSCEPTIBILITY OF PLANTS TO HYDROFLUORIC ACID AND SULFUR DIOXIDE GASES. Contrib. Boyce Thompson Inst. 18, (6) 263-89, Mar. 1956.

The effects of hydrofluoric acid (HF) and sulfur dioxide (SO2) gases were determined and compared on 49 species of plants. At given concentrations and periods of exposure some species of plants were susceptible to HF but resistant to SO2, and some species susceptible to SO2 were resistant to HF. A few species were equally susceptible to both gases, and some were equally resistant. In tests with HF alone, concentrations of the gas ranged from less than 1 to 100 parts per billion (10 to the 9th power), by volume, and periods of exposure were usually six to eight days. The concentration for SO2 gas ranged from 0.2 to 1.1 part per million (10 to the 6th power), and the time periods for exposure to the gas were two to eight hours. Special equipment and methods were developed for fumigating plants in the field and in greenhouses. Stomatal counts for upper and lower epidermis of leaves showed no relation between the number of stomata per unit leaf area and relative susceptibility to either gas. All species of plants grown in pots or under field conditions stored fluorine. A few like dogwood (Cornus florida L.), Deutzia sp., gifblaar (Dichapetalum cymosum Hook.), and Camellia sp. accumulated abnormally

large amounts of fluorine in the leaves. There was considerable difference in rate of absorption by different species when the plants were fumigated, and different parts of the plant absorbed different amounts of fluoride. These results should serve as an aid in diagnosing symptoms of vegetation around industrial areas. (Author summary)

04816

W. Schneider

CAN FLUORINE DAMAGE TO PLANTS BE ESTABLISHED BY ANALYZING THEIR ASH.Staub (English Translation) 26, (12) 29-31, Dec. 1966. Ger (Tr.)

The following precepts were obtained regarding the relationship of fluorine plant damage and the correlation to the analysis of their ash: No conclusions can be drawn from the established fluorine content of the plant ash in regard to the state of the plants, since the fluorine content of healthy and atrophied leaves is frequently identical at the same time. The content of total fluoride is not a specific, characteristic magnitude of the vegetation, but varies with location. It is, therefore, not possible to establish reference magnitudes for use as normal values. Data on fluorine content are dependent upon the dry mass of the material being analyzed. The investigation revealed the following: Damage to plants due to the effect of fluorine compounds cannot be proved by analysis of plant ash. The fluorine content determined does not give any information as to the condition and development of the plant. The fluorine content is independent of the age of the leaves.

04848

J. L. Shupe

DIAGNOSIS OF FLUOROSIS IN CATTLE. Publication of the 4th International Meeting, World Society for Buiatrik, Zurich, Switzerland, Aug. 4-9, 1966, 17p. 18 refs.

Structural and physiological processes of animals that ingest fluorine are governed by a number of factors: (1) level or amount of fluoride ingested, (2) duration of ingestion-time, (3) type and solubility of fluoride ingested, (4) age of animal at time of ingestion, (5) level of nutrition, (6) stress factors, and (8) individual biological response. Prevention and control of fluorosis in livestock can be achieved, but only when the complexity of the disease is realized and the pathogenesis, symptomatology, and lesions are properly correlated, interpreted, and evaluated. By computations, the data show that by taking into account the amount of fluorine in the rib and the tooth classification, 95 per cent ($r2=0.950$) of the variability can be accounted for. In other words, the tooth classification and the amount of fluorine in the ribs can be used to predict the extent of fluorosis with a high degree of accuracy. Other examples of multiple correlation formulas are shown. A comprehensive guide was developed to facilitate diagnosing and evaluating fluorosis. The data in the Table are based on short-and long-term controlled experiments, clinical examinations of more than 70,000 animals in endemic fluorosis areas and 519 detailed necropsy findings of animals of different ages evidencing various degrees of fluorosis. (Author's summary)

04850

Hoogstratten, B., N. C. Leone, J. L. Shupe, D. A. Greenwood, and J. Lieberman

EFFECT OF FLUORIDES ON HEMATOPOIETIC SYSTEM, LIVER AND THYROID GLAND IN CATTLE. J. Am. Med. Assoc., 192(1):26-32, April 5, 1965.

Thirty-two holstein-friesian heifers, divided into groups and fed 10, 25, 50 and 100 ppm sodium fluoride for approximately 7 1/2 years, were studied to determine the effect of fluoride on the hematopoietic system, liver, and thyroid gland. The composite and individual results of numerous detailed blood studies, identical to those used in evaluating the hematopoietic system in man, established that fluoride, fed daily in concentrations up to 100 ppm for more than seven years, (1) does not show gross, histological, or functional effects on the thyroid gland or liver; (2) does not produce significant changes in the serum calcium, phosphorus, or numerous other blood chemistries studied; (3) had a minimal blood effect in the form of a slightly higher total eosinophil count and a lower level of serum folic acid activity in the 100 ppm group; (4) does not produce anemia or detectable abnormalities of the bone marrow or otherwise affect the hematopoietic system. (Author abstract)

04904

M. Treshow, and L. G. Transtrum

SIMILARITY BETWEEN LEAF MARKINGS CAUSED BY AIR POLLUTANTS AND OTHER AGENTS: I-MOISTURE STRESS AND FLUORIDE EXPRESSION. Proc. Utah Acad. Sci., 41, (Part 1) 49-52, 1964.

The similarities and differences between the toxic effects of fluorides and moisture stress are described. Since fluoride generally causes a characteristic type of necrosis on certain plant species, there is a tendency to ascribe injury of this type to fluoride even though the species in question may be extremely resistant to fluoride. It is therefore necessary to be familiar with the response of each species to fluoride before making a diagnosis. Several guides are listed for distinguishing the cause of leaf necrosis.

04917

I. Zipkin, E. D. Eanes, and J. L. Shupe

EFFECT OF PROLONGED EXPOSURE TO FLUORIDE ON THE ASH, FLUORIDE, CITRATE, AND CRYSTALLINITY OF BOUVINE BONE. Am. J. Vet. Res. 25, (109) 1595-7, Nov. 1964.

Heifers 3 to 4 months old were allotted to 4 groups at the beginning of the experiment and were given rations containing 12, 27, 49, or 93 p.p.m. of fluoride for over 7 years. The metatarsal bones were examined for ash, fluoride, and citrate, and for crystallinity of the apatite structure. At the termination of the experiment, the fluoride concentration of the ash of the matatarsal bones had increased from 0.10% in group 1 to 1.04% in group 4 without any significant change in the percentage of the bone ash. The citrate content, expressed on an ash basis, had decreased from 1.2% to about 0.9% with a concomitant increase in crystallinity. The data obtained on bovine bone corroborated previous findings in the rat and man on the interrelation of fluoride, citrate, and the crystallinity of bone apatite.

04918

G. W. Miller and J. L. Shupe

ALKALINE BONE PHOSPHATASE ACTIVITY AS RELATED TO FLUORIDE INGESTION BY DAIRY CATTLE. Am. J. Vet. Res. 23, (92) 24-31, Jan. 1962.

Alkaline phosphatase prepared from bone and studied in vitro in relation to the effect of fluoride was relatively insensitive to fluoride. Concentrations of fluoride in excess of .01 M were required for inhibition. Experiments with dairy heifers and cows indicated a close correlation between fluoride ingested, fluoride content of the bone, osseous abnormalities, and alkaline bone phosphatase activity. Fluorosis occurred in heifers

fed rations containing 66 and 68 p.p.m. of fluoride in contaminated hay and NaF, respectively, for a period of 20 months. Additions of about 69 p.p.m. of CaF2 to the rations for 20 months caused no detrimental effect to the dairy animals. In an experiment lasting seven years and 108 days, dairy cattle were fed rations containing 12, 27, 49, and 93 p.p.m. of sodium fluoride. When the rations contained 49 or 93 p.p.m. of NaF, osseous abnormalities, excessively high accumulation of fluoride in the bone, and significant increases in alkaline bone phosphatase activity occurred. Results indicated that alakaline bone phosphatase activity was related to abnormal bone formation. (Author summary)

04919

L. E. Harris, R. J. Raleigh, G. E. Stoddard, D. A. Greenwood, J. L. Shupe, and H. M. Nielsen

EFFECTS OF FLUORINE ON DAIRY CATTLE. III. DIGESTION AND METABOLISM TRAILS. J. Animal b8sci. 23, (2) 537-46, May 1964.

Thirty-two female Holstein cattle were divided into two replications by weight and assigned to 16 treatments in a factorially designed experiment. The four levels of fluorine used were 10, 28, 55, and 109 ppm on a moisture-free hay basis; computed according to dry matter intakes, the fluorine levels were 12, 27, 49, and 93 ppm. b8two quantities, 1.0 or 3.0%, of a Ca-P mineral mixture were incorporated in a pelleted grain concentrate. Two or four pounds of the concentrate were fed during the first two metabolism trials. During the last three trials the concentrate levels were raised to 0.75 or 1.0 lb. daily per pound of milk fat produced weekly. Five digestion and metabolism trials were conducted, two before and three after the animals began to lactate. The higher quantities of concentrate tended to result in higher energy intakes and higher amounts of absorbed energy as measured by digestible and metabolizable energy. The high concentrate level did not result in significantly less fluorine retention. Likewise, the higher level of Ca-P mineral did not reduce body retention of fluorine. The results of this experiment indicate that during a 7- year period of the life of a dairy animal, the tolerance level of fluorine as sodium fluoride is between 28 and 55 ppm on a day hay basis or between 27 and 49 ppm on a total dry feed basis.

04923

J. L. Shupe, M. L. Miner, L. E. Harris, and D. A. Greenwood

RELATIVE EFFECTS OF FEEDING HAY ATMOSPHERICALLY CONTAMINATED BY FLUORIDE RESIDUE, NORMAL HAY PLUS CALCIUM FLUORIDE, AND NORMAL HAY PLUS SODIUM FLUORIDE TO DAIRY HEIFERS. Am. J. Vet. Res. 23, (95) 777-87, July 1962.

Sixteen dairy heifers were allotted to four groups on the basis of weight. The 4 heifers within each group were allotted at ramdon to the following treatments: (1) low F hay (10 p.p.m. F), (2) high F hay (62 p.p.m. F), (3) low F hay plus CaF2 (69 p.p.m. F), and (4) low F hay plus NaF (68 p.p.m. F). In addition to the hay, each animal was fed 2 lb. of grain daily. The heifers were fed for 588 days. From the data the following conclusions can be drawn: 1) The contaminated high F hay, containing fluoride emitted from a steel plant in Utah County, was as toxic as sodium fluoride; 2) Calcium fluoride proved less toxic than either the fluoride residue on the contaminated hay or the sodium fluoride; 3) Dental fluorosis can be related to the amount and type of fluoride compound ingested and can be correlated with total body reactive fluorotic processes; 4) Unequivocal bone changes were present in the animals that consumed sodium fluoride rations and hay atmospherically contaminated with fluoride; 5) From a given animal, different bones and different anatomical areas of a specific bone varied in the amounts of fluorine retained; 6) Fluoride treatmetns had no adverse effect upon the soft tissues of the body; and 7) Fluorine apparently did not influence feed utilization as measured by digestibility and balance trials. (Author summary)

04924

J. L. Shupe, L. E. Harris,D. A. Greenwood, J. E. Butcher, and H. M. Nielsen

THE EFFECT OF FLUORINE ON DAIRY CATTLE. V. FLUORINE IN THE URINE AS AN ESTIMATOR OF FLUORINE INTAKE. Am. J. Vet. Res. 24, (9) 300-6, Mar. 1963.

Thirty-two Holstein-Friesian cows were fed four levels of fluorine, two levels of calcium-phosphorus mineral, and two levels of a concentrate mix from about 3 months to 7.5 years of age. Two digestion and balance trials were conducted before calving and three after the animals started to lactate. In addition, after the cows were on trail for 7 years and 52 days, urine was collected approximately every 1.5 hours and composited for each 3-hour interval over a 24-hour period. During these and previous studies, it was found that urine samples should be taken in the morning for best results and that, when possible, samples of urine should be obtained from several cows and the results pooled to give a reliable index of the fluorine consumed. The determination of the fluorine: creatinine ratio was found to have merit as a means of adjusting for differences in urine volumes. A correlation was found to exist among concentration of fluorine in the urine, amount of fluorine in dry matter consumed, and length of time that fluorine is ingested. By determining parts per million (p.p.m.) of fluroine in the urine and combining this with a knowledge of the length of time the animals had ingested fluorine, the p.p.m. of fluorine in the ingested dry matter could be estimated. Taken alone, however, this measurement was an inadequate criterion for a definite diagnosis of fluorisis in cattle. (Author summary)

04925

E. E. Stoddard, L. E. Harris, G. Q. Bateman, J. L. Shupe, and D. A. Greenwood

EFFECTS OF FLUORINE ON DAIRY CATTLE. I. GROWTH AND FEED CONSUMPTION. J. Dairy Sci. 46, (10) 1094-102, Oct. 1963.

Thirty-two Holstein females on experiment from about three to four months until about 7.5 yr of age were fed diets involving four levels of fluorine, two levels of concentrate mix, and two levels of a calcium-phosphorus mineral. Fluorine intake averaged 10, 28, 55, and 109 ppm on a hay basis or 12, 27, 49, and 93 ppm on a total dry matter basis. Average calculated levels of fluorine in milligram per kilogram of body weight were 0.30, 0.64, 1.17, and 2.08, respectively, for the four groups, with some variation associated with periods of growth and lactation. The two levels of concentrate were 2 and 4 lb daily during nonlactating periods and 0.75 and 1.0 lb daily for each 1.0 lb of milk fat produced weekly during lactation. Mineral treatments included 1 and 3% of a calcium-phosphorus mineral in the concentrate mix. Fluorine was maintained at designated levels by adding sodium fluoride to the concentrate mix. Animals on the highest fluorine level ingested less hay and total dry matter than those on the other fluorine levels, but did not exhibit a significantly lower body weight gain during the 23, 112-day periods of the trial. No significant effects were noted on increase in height at withers. The kilograms of feed per kilogram of body weight gain was not affected by

treatments in the five prelactation periods. Hay refusals were not affected by treatment. It was observed that no single criterion was as effective in evaluating effects of fluoride ingestion as was an evaluation of all effects together. (Author summary)

04984

P. W. Zimmerman

IMPURITIES IN THE AIR AND THEIR INFLUENCE ON PLANT LIFE. Proc. Natl. Air Pollution Symp., 1st, Pasadena, Calif., 1949 pp. 135-41

The fact that several impurities in the air influence plant life has been fairly well established. The toxic impurities most frequently encountered are sulphur dioxide, hydrogen fluoride, chlorine, hydrogen sulphide, ammonia, esters of growth- regulating substances, and constituents of manufactured illuminating gas. To aid in identifying characteristic effects, several species of plants have been subjected to these gases under controlled experimental conditions.

04997

P. H. Phillips

THE DEVELOPMENT OF CHRONIC FLUORINE TOXICOSIS AND ITS EFFECT ON CATTLE. Proc. Natl. Air Pollution Symp., 2nd, Pasadena, Calif., 1952. pp. 117-21.

A progress report is presented of the experiment on fluorosis at the University of Wisconsin, in which theefffect of the ingestion of a soluble fluoride was studied. The abrupt addition of 50 p.p.m. of sodium fluoride fluorine to the ration of young dairy cows failed to affect their appetite, failed to produce diarrhea, and failed to reduce milk production significantly. Urinary fluoride measurement is a qualitative measurement which indicated elevated fluorine ingestion, but a single sample analysis is too variable to be quantitative, although it may be considered roughly quantitative. Typical criteria of fluorosis have not been produced in these young dairy cows by the inclusion of as much as 50 p.p.m. of sodium fluoride-borne fluorine in the diet during the first twelve months' period. Exposure to 50 p.p.m. of added dietary fluorine (sodium fluoride) failed to reduce milk production in the first year of experiment.

05004

D. A. Greenwood, J. L. Shupe, G. E. Stoddard, L. E. Harris, H. M. Nielsen, and L. E. Olson

FLUOROSIS IN CATTLE. Utah State Univ., Logan, Agricultural Experiment Station. (Special Rept. No. 17.) 1964. 36 pp.

Investigations of fluorosis in dairy females were conducted by Utah State University personnel in an effort to achieve the following overall objectives: 1. To determine the influence of different levels of fluoride intake on feed consumption and utilization, growth, milk production, and reproduction when the animals started ingesting the fluorides at 3 to 4 months of age. 2. To determine relative effects of ingestion of different types of fluorides, including sodium fluoride, calcium fluoride, and fluoride as a residue on hay; and of exposure to a fluoride- contaminated atmosphere. 3. To determine the effects of fluoride ingestion on tissue structure and on metabolic processes such as dentition, bone formation, organ functions, and enzyme activities. 4. To determine whether elevated intake levels of aluminum, calcium, phosphorus, and grain would reduce effects of fluoride ingestion. 5. To determine fluoride ingestion tolerance levels. In addition, the overall objectives were broadened in potential applicability by annual surveys of selected animals in the endemic fluorosis area. Evaluations of clinical findings from these surveys were correlated with vegetative analyses when possible, and with detailed necropsy studies of selected field cases of both dairy and beef animals of different ages that evidenced varying degrees of fluorosis. This information then was correlated with the data from the controlled experiments.

05324

Brewer, R. F. F. B. Guillemet, and F. H. Sutherland

THE EFFECTS OF ATMOSPHERIC FLUORIDE ON GLADIOLUS GROWTH, FLOWERING AND CORM PRODUCTION.Proc. Am. Soc. Hort. Sci. 88, 631-4, 1966.

The effects of hydrofluoric acid gas on growth, flowering and corm production of glasiolus, associated with variable degrees of visible damage to foliage, were studied under controlled greenhouse conditions. Plants with leaf injuries approximating 10, 20, and 30 percent of the total leaf area were compared with control plants grown in F-free air. Flower size and weight and number of florets per spike were reduced as the severity of F injury increased. Corm size and weight were reduced in direct proportion to the extent of leaf injury. Total top weight (leaves and flowers) was inversely related to leaf injury. The variety Snow Princess was more severly affected than Elizabeth the Queen. (Author abstract)

05342

Darley, E. F., Nichols, C. W. and Middleton, J. T.

IDENTIFICATION OF AIR POLLUTION DAMAGE TO AGRUCULTURAL CROPS. (AIR POLLUTION RESEARCH REVEALS CHEMICAL TOXICANTS INJURING VEGETATION IN POPULOUS AREAS OF CALIFORNIA.)Calif. Dep. Agri. Bull., 55(1):11 19, 1966.

The subject of this paper is the damage air pollution does to the plants that feed us, clothe us and please our aesthetic sense. This damage is considerable. Estimates of visible damage to agricultural crops amount annually to about $8 million in California and approximately $18 million along the Atlantic seaboard. Damage to vegetation has increased with industrialization and urban development. Several decades ago sulfur dioxide and fluorine were recognized as the principal plant toxicants. These two gases continue to be very important but within the last 20 years a new group of toxicants has been identified. These are products of atmospheric photochemical reactions between hydrocarbons and nitrogen oxides. The principal products of these reactions are ozone and the peroxyacyl nitrates (PANs). The distribution of plant damage in California shows that it occurs only in recognized geographical areas which, in each instance, are located within airsheds. Because damage to plants is often the first indication of air pollution, it is important that the surveillance of pollution damage to agriculture be continued. Such information will help communities, in their planning, to take cognizance of the relationship between the air ressource and the community needs for commercial and industrial development, energy production, fuel usage and transportation, agriculture, and forest and recreation land. The air contaminants responsible for damage may be either particulate or gaseous in nature. The greatest amount of damage to animals and vegetation is usually caused by gaseous air contaminants which directly injure plants and indirectly injure animals by the toxic effects produced after the animal has consumed contaminated forage and food supplements.

05398

S. F. Yang and G. W. Miller

BIOCHEMICAL STUDIES ON THE EFFECT OF FLUORIDE ON HIGHER PLANTS, I. METABOLISM OF CARBOHYDRATES, ORGANIC ACIDS AND AMINO ACIDS. Biochem. J. 88, 505-9, 1963.

The metabolic changes in carbohydrates, organic acids and amino acids that accompanied the development of necrosis resulting from atmospheric fluoride fumigation were studied. Soya bean plants were placed in fumigation chambers when 6-8 in. tall. Treatments consisted of fumigations with air which was contaminated with 0.00006 p.p.m. of HF (control), and with 0.03 p.p.m. of HF in air. The leaves were harvested after 3-5 days of fumigation, depending on when marginal burning first became evident. Fluoride-fumigated leaves contained more reducing sugars and less sucrose than the normal leaves. This result suggested inhibition of sucrose synthesis by fluoride. Necrotic leaves contained increased total concentrations of organic acids, which were mostly attributable to malic acid, malonic acid and citric acid. The greater increase in malic acid relative to that of citric acid was the reverse of results observed in chlorotic tissue. Necrotic leaves contained enhanced amounts of free amino acids. The greatest increase occurred in the concentration of asparagine and might be related to the increased respiratory rate of necrotic leaves. The accumulation of organic acids and amino acids in leaves during fluoride fumigation was evidenced by a lowered respiratory quotient.

05399

Yang, S. F. and Miller, G. W.

BIOCHEMICAL STUDIES ON THE EFFECT OF FLUORIDE ON HIGHER PLANTS. 3. THE EFFECT OF FLUORIDE ON DARK CARBON DIOXIDE FIXATION. Biochem. J. 88, 517-22, 1963.

This investigation was initiated to determine whether the accumulation of organic acids and amino acids in fluoride-necrotic leaves was due to the increased rate of dark CO2 fixation, and how fluoride might affect the carboxylating enzyme systems. Soya beans were grown and fumigated with HF. At the end of fumigation, one control plant and one fumigated plant that showed slight necrotic symptoms were put into a 6 l. desiccator. After the introduction of 14CO2, the desiccator was kept air-tight and in complete darkness for 4 hr. At the end of the dark 14CO2 fixation, leaves from each plant were cut off and analyzed for radioactive organic acids and amino acids, ethanol-insoluble nitrogen and soluble protein, and, phosphoenolpyruvate-carboxylase activity. Necrotic leaves had a higher rate of dark CO2 fixation than control leaves both in vivo and in vitro. Results suggested that the accumulation of organic acids and amino acids in necrotic leaves resulted from an increased rate of dark CO2 fixation. The possible role of fluoride in stimulating the carboxylation and its implication to necrosis are discussed.

05421

Merriman, G. M.

FLUORIDES AND OTHER CHEMICAL AIR POLLUTANTS AFFECTING ANIMALS. In: Agriculture and the Quality of Our Environment. Brady, N. C. (ed.), American Association for the Advancement of Science, Washington, D. C. AAAS-Pub-85, p. 91-95, 1967. 11 refs. (Presented at the 133rd Meeting, American Association for the Advancement of Science, Washington, D. C., 1966.)

A review of air pollution problems involving animals is presented. One pattern of procedures useful in investigating and controlling the effects of chemical air pollution upon animals was developed during United States and British studies of effects of fluoride effluents upon cattle. Generally the effluents collected upon the surfaces of vegetation and exerted their effects only after ingestion by animals. The investigational procedures included methods of detecting pollutant effects upon animals, diagnosis and evaluation of effects, consideration of pollutant sources, and pollutant control as related to animal well-being. All procedures depended on research with laboratory and farm animals.

05485

W. M. Noble

AIR POLLUTANTS. Lasca Leaves. 15 (1), 7-18 (Jan. 1965).

After years of careful study, some of the components of smog have been sorted out. The more important ones, their effects on vegatation, and a list of sensitive and resistant plants are discussed. The components are peroxyacetyl nitrate, ozone, ethylene, hydrogen fluoride, sulfur dioxide and aerosols.

05560

C. R. Berry

EASTERN WHITE PINE-EVERGREEN MONITOR OF AIR POLLUTION. Preprint. (Presented at the Second National Conference on Air Pollution, Washington, D.C., Dec. 12-14, 1966.)

Six hundred healthy, 2-year-old seedlings were potted and taken to Morgan County, Tenn., where they were installed near a power plant known to be the sulfur dioxide source. After a year of exposure, 106 of the trees had died, either from handling, air pollution damage, or both. Those surviving included 183 that were free of damage and 106 that were only slightly injured. These were presumed resistant to sulfur dioxide and were taken to the Alabama test area for exposure to fluorides. The remaining 202 trees showed serious damage, so they were returned to the recovery area in North Carolina. After a year of exposure in Alabama, 157 injured trees were again removed and sent to North Carolina for recovery. The remaining 26 seedlings still appeared healthy, and they were presumed to be resistant to both sulfur dioxide and fluorides. The healthy trees were moved to Beltsville, Md., where they are still under exposure to oxidants produced by heavy motor traffic. Although, the exposure period is not over, and final figures may be different, 13 trees have been injured and 13 still appear healthy. It is hoped that seedlings from seed of superior trees will be inherently resistant to damage from sulfur dioxide, fluorides, oxidants, and other airborne toxicants. On the other hand, susceptible trees that recover in the clean air in North Carolina may make excellent assay plants because of their demonstrated sensitivity to oxidants at Beltsville. The results of these tests indicate there is enough genetic variation in a large eastern white pine population to provide biological indicators for specific toxicants.

05585

R. A. Solberg, D. F. Adams, and H. A. Ferchau

SOME EFFECTS OF HYDROGEN FLUORIDE ON THE INTERNAL STRUCTURE OF PINUS PONDEROSA NEEDLES. Proc. Natl. Air Pollution Symp., 3rd, Pasadena, Calif. 164-76 (1955)

Pinus ponderosa trees were submitted to fumigations of 0.5, 1.5, 5.0, and 10.0 p.p.b. hydrogen fluoride. Samples were taken and comparisons made of microscopic cross-sections of injured and uninjured (control) needles. Observations of fu-

migated needles yielded the following results. Over-all needle damage was in the form of browning of the needle apexes, which gradually progressed basipetally. 2nward collapse of the interior needle surfaces was observed in all needles showing macroscopic injury. Microscopic changes in the green needle tissue, presumably due to fluoride, were observed only in the tissue immediately adjacent to macroscopically browned areas and were of an intermediate type. The epidermis, hypodermis, and xylem tissues exhibited the least injury of the tissues studied. The phloem and xylem parenchyma enlarged greatly. Extreme needle damage showed the phloem to be collapsed against the xylem tissue. (Author summary modified)

05612

H. C. Wohlers and G. W. Newell

A FIELD INVESTIGATION OF FLUOROSIS IN CATTLE. J. Air Pollution Control Assoc. 14(5):139-148, May 1964. (Presented at the 56th Annual Meeting, Air Pollution Control Association, Detroit, Mich., June 9-13, 1963.)

A comparison has been made of the results of a detailed field investigation of the effects of fluoride on cattle with research results from controlled feeding experiments. Specifically, the comparison was made on the basis of the fluoride content in the feed, the fluoride content of the ribs, the fluoride content of the urine, and the fluoride effect on incisor practical field study, it has been shown that fluorosis in cattle might be expected within a two-mile distance of these industrial plants. At this distance, the following conditions were determined: (1) The forage contained more than 40 to 50 ppm F-- approximately two mg F/kg of body weight per day; (2) The fluoride content of the rib exceeded 4000 ppm; (3) The fluoride content of the urine exceeded 15 ppm; and (4) Almost 50% of the incisor teeth examined were marked with excessive mottling. Correlation of the results of a field experiment with the results of controlled feeding experiments was excellent. With these comparison data, we have shown that it is possible to delineate herds or areas in which damaging or non-damaging effects of fluoride might be expected. (Authors' summary, modified)

05667

R. F. Brewer, F. H. Sutherland, F. B. Guillemet, and R. K. Creveling

SOME EFFECTS OF HYDROGEN FLUORIDE GAS ON BEARING NAVEL ORANGE TREES. Proc. Am Soc. Hort. Sci. 76, 208-14, 1960.

The experiment reported in this paper was designed to study the effects of several years of continuous exposure to 1-5 ppb HF on growth, fruiting, toxicity symptoms, and fluoride accumulation by young orange trees. Eight 1-year old field grown Washington navel orange trees were used in the study. In March, 1957, after approximately 5 months of continuous exposure to 3 to 5 ppb HF, the trees began to show effects of the fluoride treatment. In late May and early June, a considerable amount of chlorosis and some necrosis, principally at the tips of nearly mature leaves, appeared on the trees exposed to the fluoride gas. There was some chlorotic foliage on control trees, but the extent and severity of chlorosis on fumigated trees were markedly greater. Although the chlorosis patterns varied somewhat, they resembled manganese deficiency symptoms on citrus. Some of the symptoms resembled the type of injury commonly associated with excess boron. After 13 months of continuous treatment, comparison with control trees indicated significant reductions in trunk diameter, height of tree, crown volume and average leaf size. The data indicate that the navel orange is sensitive to low concentrations (2 to 3 ppb) of HF in the air. The fluoride-induced chlorosis observed in this experiment would be almost impossible to diagnose under field conditions without laboratory analysis of leaf tissue. The most pronounced effect of HF on growth was a 25 to 35 per cent reduction in average leaf size.

05724

J. B. Kendrick, Jr., E. F. Darley, J. T. Middleton, and A. O. Paulus

PLANT RESPONSE TO POLLUTED AIR. Calif. Agr. 10 (8), 9-10 (Aug. 1956).

Field observations and controlled fumigation experiments have shown that plants differ in their response to atmospheric contamination by ethylene, herbicides, fluorides, sulfur dioxide, and smog, or oxidized hydrocarbons. Controlled experiments have also shown that plant response to air pollution varies with species and variety of plant, age of plant tissue, soil fertility levels, soil moisture, air temperatures during the prefumigation growth period, and presence of certain agricultural chemicals on leaves. Plants also vary in their susceptibility to sulfur dioxide, with alfalfa, barley, and cotton damaged at comparatively low levels, and citrus, corn, celery, and melons damaged at much higher levels. Field observations show that young leaves are seldom marked during periods of aggravated air pollution. The young, unexpanded leaves are typically uninjured; the mature, expanded leaves are severely injured; and the old, somewhat chlorotic leaves are rarely damaged. In grasses, where the youngest tissue is at the base of the leaf, injury first occurs at the tip, grading off in intensity of injury toward the base of the leaf. Old chlorotic leaves on grasses are seldom injured. Several groups of chemical compounds are capable of preventing injury to plants caused by oxidized hydrocarbon fumigations when the chemicals are applied to the lower surface of leaves. These chemicals belong to the dithiocarbamate, benzothiazole, and thiuram sulfide groups, and have been used extensively as agricultural fungicides for the control of many fungus diseases. Two of the best chemicals for this purpose are zineb--zinc ethylenebisdithiocarbamate -- and thiram--tetramethyl thiuramdisulfide. The degree of protection is directly related to the amount of active ingredient contained in the spray or dust preparations. Protection is achieved only when the underside of leaves are adequately covered. Both groups of chemicals when properly applied to laboratory test plants protect leaves from damage from both ozone and ozonated hexene. Pinto bean leaves dusted with zineb in the laboratory and exposed to naturally polluted air near Los Angeles were protected from serious injury.

05744

Ordin, L. and B. P. Skoe

INHIBITION OF METABOLISM IN AVENA COLEOPTILE TISSUE BY FLUORIDE. Plant Physiol., 38(4):416-421, July 1963. (Presented at the American Society of Plant Physiologists' Annual Meeting, Corvallis, Oreg., Aug. 30, 1962.)

Following treatment of Avena coleoptile sections with 0.01 N NaF for 6 hrs, an 80% inhibition of growth in the presence of 0.05 M glucose and 2.9 times 10 to the minus fifth molar indoleacetic acid ensued, followed by partial recovery in fluoride-free solutions. Studies of glucose utilization in the absence of indoleacetic acid showed the absorption of uniformly labeled C14 glucose was barely affected but inhibition of incorporation of C14 into cellulose and the glucose components of the aqueous and acid-soluble wall fractions was particularly notable. Possible causes of an apparent effect of 0.01 N NaF pretreatment for 6.5 to 7 hrs on respiratory pathways, detected by the use of specifically labeled glucose,

are discussed. At lower levels of inhibition of growth, the effect of catabolism disappeared but certain effects on the cell wall were still apparent. Interference with metabolism of specific components of the wall including cellulose is considered to be a factor in fluoride inhibition of growth. (Author summary)

06342

C. W. Chang and C. R. Thompson

STUDY OF PHYTASE AND FLUORIDE EFFECTS IN GERMINATING CORN SEEDS. Cereal Chem., 44 (2), 129-42 (Mar. 1967).

Some properties of phytase enzyme were studied using the 1700 x g fraction of endosperm-scutellar tissue homogenate of 4-day old corn seedlings. The highest total enzyme activity was located in the fraction at 1700 X g, while the supernatant at 20,000 X g was found to be the location of the highest specific enzyme activity. The enzyme resisted high temperature (up to 50 degrees), was activated by calcium chloride (0.01 M), and was inhibited significantly by sodium fluoride ranging from 10 to 0.05 mM. A rapid decomposition of phytin content was correlated with steady rises of phytase activity and inorganic phosphate in the endospermscutellar tissues of germinating corn seedlings. Fluoride, however, prevented the dephosphorylation of phytin compound in the tissues and retarded the rate of seedling root growth during germination. There occurs continuous turn over between inorganic phosphorus and nucleotides in RNA metabolism. It is assumed that the limited supply of phytin-originated orthophosphate may be possibly one of the factors, which influences the growth rate of corn seedling roots.

06353

G. M. Merriman and C. S. Hobbs

BOVINE FLUOROSIS FROM SOIL AND WATER SOURCES. Tennessee Univ., Agr. Expt. Sta. Bull. 347 (Sept. 1962). 50 pp.

The effects upon cattle of soil-borne and water-borne fluorine (F), level of nutrition, and aluminum sulfate were studied. Records were kept on (1) cow weights and gains; (2) reproduction and calf gains; (3) F concentrations in cow and calf bones; (4) urinary F concentrations; (5) changes in teeth; and (6) general health. Nine treatments in replicate with each of the eighteen lots containing five Hereford cows and heifers per lot were used as follows: (1) Low fluorine soil, low fluorine water, good nutrition: (2) Low fluorine soil, low fluorine water, low nutrition: (3) Low fluorine soil, high fluorine water, goo nutrition: (j) Low fluorine soil, high fluorine water, low nutrition: (5) Hugh fluorine soil, low fluorine water, good nutrition; (6) High fluorine soil, low fluorine water, low nutrition: (7) High fluorine soil, high fluorine water, good nutrition; (8) High fluorine soil, high fluorine water, low nutrition; and (9) High fluorine soil, high fluorine water, low nutrition plus aluminum sulfate. The soil F concentration in low fluorine soil (LFS) pastures ranged from 380 to 600 ppm F and in high fluorine soil (HFS) pastures from approximately 2,000 to 4,100 ppm F. The following conclusions are reported: F content in soil, pasture and water caused no significant difference in weights and gains of cows. There was no significant effect from concentrations of F in soil or water, levels of nutrition, or the feeding of aluminum sulfate, upon the reproduction of cows or the average daily weight gains of calves. Increased age with continuous F ingestion resulted in highly significant increases in bone F storage. A study of all calf bone analyses showed that the higher level of F in soil caused highly significant increases of F concentration in these bones. Composite urine samples collected from cows on HFS pastures were found to have significantly higher concentrations of F than samples collected from the cows on LFS treatments. Highly significant increases in incisor teeth indexes were found in HFS cattle compared to those on LFS treatments. The F levels in soil, vegetation and water or the levels of nutrition had no effect upon the general health of the animals.

06354

C. S. Hobbs and G. M. Merriman

FLUOROSIS IN BEEF CATTLE. Tennessee Univ., Agr. Expt. Sta. Bull. 351. (Oct. 1962.) 189 pp.

Cows were used in the study of physiologic effects of various levels of ingested fluorine. Fluorine as sodium fluoride or raw rock phosphate was added to concentrate feeds for some groups of cows while other groups consumed hay, or hay and pasture, contaminated with fluorine from an industrial source. Aluminum sulfate hydrate was added as an alleviator to rations containing sodium fluoride. Groups of cows were removed after approximately 100, 200, 400, 600, and 800 days on pastures contaminated with fluorine from an industrial source. Cattle were started on experiment at 14 to 22 months of age. The studies covered various periods up to 10 years, providing data indicating the following: (1) feed consumption; (2 weights and gains; (3) reproduction and calf records; (4) fluorine content of bones; (5) blood studies; (6) urinary fluorine; (7) teeth; and (8) gross changes in bone and other tissue. It is concluded that the occurrence and degree of fluorosis in cattle depends upon many factors including: (1) the level of fluorine ingested; (2) the age of the animal and the stage of tooth development; (3) the length of time exposed to the increased fluorine ingestion; (4) the initial fluorine stored in the animal's body; and (5) the solubility and availability of the fluorine material ingested. (Author summary modified)

06395

Hindawi, I. J.

INJURY BY SULFUR DIOXIDE, HYDROGEN FLUORIDE, AND CHLORINE AS THEY WERE OBSERVED AND REFLECTED ON VEGETATION IN THE FIELD. Preprint, Air Pollution Control Assoc., Pittsburgh, Pa. (Presented at the Air Pollution Control Association, Annual Meeting, 60th, Cleveland, June 11-16, 1967, Paper 67-159.)

Plants were examined at three different locations in the eastern part of the United States to determine whether damage from air pollution had occurred. This paper discusses sulfur dioxide damage in the Metropolitan New York City Area, hydrogen fluoride damage near a glass fiber manufacturing plant in the Mid-west, and hydrochloric acid mist and chlorine damage from a manufacturing operation in an eastern state. The symptoms that developed in vegetation were often found to be similar. Chemical and microscopical analyses were helpful in diagnosing the toxicants. (Author abstract)

06404

D. C. MacLean, D. C. McCune, L. H. Weinstein, R. H. Mandl, G. N. Woodruff

EFFECTS OF ACUTE HYDROGEN FLUORIDE AND NITROGEN DIOXIDE EXPOSURES ON CITRUS AND ORNAMENTAL PLANTS OF CENTRAL FLORIDA. Preprint. (Presented at the 60th Annual Meeting, Air Pollution Control Association, Cleveland, Ohio, June 11-16, 1967, Paper No. 67-158.)

Six citrus varieties and six ornamental species of economic importance to Central Florida were subjected to high concentra-

tion-short duration exposures of gaseous hydrogen fluoride (HF) or nitrogen dioxide (N02). Pose-fumigation observations showed that the effects of acute pollutant exposures differ markedly from those of chronic exposures. HF exposures of 0.5 to 10 ppm and durations of from 30 minutes to 8 hours induced tip, marginal, and intercostal chlorosis and necrosis and abscission of leaves of most plants tested. Injury was most severe on, but not limited to, young leaves. The effect of duration of exposure had a greater influence on abscission of young citrus leaves than did HF concentration. However, the effect of HF concentration on foliar F accumulation could not be separated from exposure time. NO2 concentrations used ranged from 25 to 250 ppm for durations of from 10 minutes to 8 hours. NO2 damage was characterized by rapid tissue collapse, necrosis, and defoliation. Injury was sporadic in appearance, affecting leaves of all ages. The relative contributions of concentration and duration to NO2-induced injury were about equal. (Author abstract)

06413

A. H. Mohamed

CYTOGENETIC EFFECTS OF HYDROGEN FLUORIDE TREATMENT IN TOMATO PLANTS. J. Air Pollution Control Assoc., 18(6):395-398, June 1968. 21 refs. (Presented at the 60th Annual Meeting, Air Pollution Control Association, Cleveland, Ohio, June 11-16, 1967. Paper 67-19.)

Seeds from tomato plants fumigated with hydrogen fluoride gas at a concentration of about three micrograms per cubic meter were planted in pots in the greenhouse. A number of plants in each culture were found to be developing abnormally. These abnormalities consisted of one, three or four cotyledons; deformed cotyledons; plumuleless seedlings; fasciated petioles, wiry seedlings, double stalk plants; and dwarf seedlings. Such abnormal phenotypes were the same as, or similar to known mutants. There was a trend toward a higher percentage of total phenotypic abnormalities with an increase in the treatment duration. Offspring of the fumigated plants showed the occurrence of fragments or bridges plus fragments. There was also a trend toward a higher percentage of chromosomal aberrations with an increase in the treatment duration except for the 4 day duration which was higher than most of the other treatments. It is believed that the occurrence of these aberrations was due to crossing over in heterozygous paracentric inversions. These results suggest that HF is a mutagenic agent probably blocking directly or indirectly, the replication of the DNA. (Author abstract)

06459

Thompson, C. R., J. O. Ivie, and M. D. Thomas

CONTINUOUS RECORDING OF AIR POLLUTANTS AND THEIR EFFECTS ON BEARING CITRUS. Preprint., 1960

Decline in citrus production and fruit quality is reported by growers during the past 15 years in the Los Angeles Basin. Air pollution is considered to be a major factor contributing to this problem. An industry-agriculture-local government-university sponsored, cooperative study entitled the Agricultural Air Research Program was begun in 1960 to assess the economic effect of various air pollutants, principally oxidants and fluorides, on fruit yield, quality and tree growth. Measurements of photosynthesis and transpiration are used to supplement the longtime growth and yield observations. Automatic data recording is provided for: (1) apparent photosynthesis by carbon dioxide exchange: (2) plant transpiration; (3) nitrogen dioxide; (4) nitric oxide: (5) ozone; (6) total oxidants; (7) fluorides; (8) temperatures; (9) integrated sun light recording; (10) date, and (11) time of day. With punch card recording, direct automatic handling of the data on the 1620 IBM computer is possible. The initial experiment is being conducted at Upland, California on 24 lemon trees with six treatments as follows: (1) Clean Air; (2) ambient air; (3) fluoride-free air; (4) ozone-free air; (5) clean air with fluoride added; and (6) fluoride and ozone free air. Four unenclosed trees serve as checks. Plans are underway for similar experiments in other locations with both lemons and oranges. (Authors' summary)

06557

I. A. Leone, E. Brennan, R. H. Daines

PLANT LIFE AS AIR POLLUTION INDICATORS. Proc. Northeast. Weed Control Conf. 18, 451-5 (1964).

Plants display a particular talent for indicating the presence of very low concentrations of pollutants in the atmosphere. Agricultural people are concerned with two broad groups of pollutants, the primary or single source emissions which are the result of a particular industrial or fuel-utilizing process, and the products of photochemical reactions which are the result of a whole complex of combustive activities in urban areas. The primary phytotoxic contaminants include hydrogen fluoride, chlorine , sulfur dioxide, ammonia, hydrogen sulfide, ethylene and perhaps illuminating gas. The remarkable thing about these phytotoxicants is that each one severely affects a particular group of plants which is more or less tolerant to the other pollutants. For that reason plant indicators are very useful in diagnosing the specific gas or gases responsible for an air pollution episode, if observed during their optimum growth period.

06681

A. H. Mohamed, H. G. Applegate, and J. D. Smith

CYTOLOGICAL REACTIONS INDUCED BY SODIUM FLUORIDE IN ALLIUM CEPA ROOT RIP CHROMOSOMES . (Can J. Genet. Cytol. Ottawa) 8, 241-4 (1966).

The cytological effect of an aqueous sodium fluoride solution of 0.01 M was studied on onion root tip chromosomes. Root tip smears showed that this chemical agent was able to induce anaphase bridges and fragments. Tetraploid nuclei and multipolar anaphases were also observed. From the cytological results presented here, it is apparent that sodium fluoride in an aqueous solution has a specific action on onion root tip chromosomes as well as on the spindle. Not all of the cytological effects reported here were necessarily visible at the same time. The formation of anaphase bridges is considered to be the result of the development of dicentric chromosomes with the two centromeres of each dicentric chromosome oriented towards the opposite poles. The dicentric chromosomes presumably arise by the reunion of the two sister chromatids of a broken chromosome. Such fusion takes place at the time of chromosome duplication. This may indicate that sodium fluoride acts on chromosomes during interphase, since it has been shown that DNA replication occurs during this phase. Since the majority of the bridges were found after 14 and 48 hr. of treatment, it appears possible that anaphase bridges are being carried over from one mitotic cycle to the next through the initiation of a breakage-fusion-bridge-cycle.

07046

C. J. Lovelace G. W. Miller

IN VITRO EFFECTS OF FLUORIDE ON TRICARBOXYLIC ACID CYCLE DEHYDROGENASES AND OXIDATIVE PHOSPHORYLATION: PART I. J. Histochem. Cytochem. 15 (4), 195-201 (1967).

It appears that an initial effect of fluoride on plants involves either inhibition or enhancement of respiration with the specific result depending upon plant species, fluoride concentration and extent of injury. This study is made in an effort to elucidate further the effects of fluoride on oxidative phosphorylation and succinic dehydrogenase in higher plants. The in vitro effect of fluoride on the succinic oxidase system was studied, utilizing mitochondria from cauliflower. Preincubation of mitochondria with fluoride did not increase inhibition of succinic oxidase. Various other tricarboxylic acid cycle substrates when tested showed no sensitivity to fluoride. A series of succinate concentrations in the presence and in the absence of fluoride showed increased activity of succinic dehydrogenase which indicated competitive inhibition. Various concentrations of phosphate in the absence of fluoride showed that phosphate had only slight effects on the succinic 2,6-dichlorophenolindophenol reductase component of the oxidase system. In the absence of phosphate, various concentrations of fluoride showed an initial increase in activity followed by a decrease in activity of the reductase. In the presence of phosphate, fluoride caused marked inhibition of the reductase. It is believed that this inhibition results from an enzyme-fluorophosphate complex which has a lower dissociation constant than that of the enzyme-substrate complex. An oxidative phosphorylation study indicated both respiration and phosphorylation were inhibited. (Author abstract modified)

07047

C. J. Lovelace G. W. Miller

HISTOCHEMICAL INVESTIGATIONS ON THE IN VIVO EFFECTS OF FLUORIDE ON TRICARBOXYLIC ACID CYCLE DEHYDROGENASES FROM PELARGONIUM ZONALE: PART II. J. Histochem. Cytochem. 15 (4), 202-6 (1967).

In vivo effects of fluoride on tricarboxylic acid (TCA) cycle dehydrogenase enzymes of Pelargonium zonale, the variegated geranium, were studied using p-nitro blue tetrazoleum chloride. Plants were exposed to 17 ppb HF, and enzyme activities in treated plants were compared to those in controls. Leaves of control plants were incubated in 0.005 M sodium fluoride. Injuries observed in fumigation and solution experiments were similar. Leaf tissue subjected to HF or sodium fluoride evidenced were similar. Leaf tissue subjected to HF or sodium fluoride evidenced less succinic p-nitro blue tetrazoleium reductase activity than did the control tissue. Other TCA cycle dehydrogenase enzymes were not observably affected by the fluoride concentrations used in these experiments. Excised leaves cultured in 0.005 M sodium fluoride exhibited less succinic p-nitro blue tetrazoleum reductase activity after 24 hr than did leaves cultured in 0.005 M sodium chloride. (Author's abstract)

07255

Thompson, C. R., O. C. Taylor, M. D. Thomas, and J. O. Ivie

EFFECTS OF AIR POLLUTANTS ON APPARENT PHOTOSYNTHESIS AND WATER USE BY CITRUS TREES. ((Environ. Sci. Technol.,)) 1(8):644-650, Aug. 1967. 20 refs.

Because of the major damage to crops by air pollutants, studies were begum to measure under field conditions, the effect of various atmospheric phytotoxicants on agricultural crops in the Upper Santa Ana Drainage Basin. There was question as to whether photochemical smog and/or fluorides were responsible for major economic losses by the citric industry and if so, how much. Commercially producing lemon and navel orange trees were tested to determine the effects of ambient air pollutants which occur in the Los Angeles basin on water use (transpiration) and apparent photosynthesis. The entire trees were enclosed in plastic covered greenhouses and were supplied various fractions of the atmosphere to find whether ozone, peroxyacyl nitrates, or fluorides were causing deleterious effects. Nitric oxide was added to the air in one treatment to reduce ozone selectively but in so doing, nitrogen dioxide in amounts equal to the ozone was formed. The results showed that the total photochemical smog complex reduced the rate of water use by lemon trees and also reduced the rate of apparent photosynthesis. Fluoride levels occurring in the atmosphere caused no detectable effects. Attempts to evaluate the separate effects of ozone and peroxyacyl nitrates were unsuccessful. Reduction of the ozone in the tree atmospheres by addition of nitric oxide failed to overcome the reduced water use and lowered apparent photosynthesis. (Author abstract modified)

08513

Pack, Merrill R.

INFLUENCE OF HYDROGEN FLUORIDE FUMIGATION ON ACID-SOLUBLE PHOSPHORUS COMPOUNDS IN BEAN SEEDLINGS. Environ. Sci. Technol., 1(12):1011-1013, Dec. 1967. 23 refs. (Presented at the Division of Water, Air, and Waste Chemistry, 153rd Meeting, ACS, Miami Beach, Fla., April 1967.)

Bean seedlings were grown for four days following emergence in an atmosphere containing hydrogen fluoride (HF) at 14 + micro of fluorine per cu. meter. Their acid-soluble phosphorus composition was compared with that of seedlings grown in a decontaminated atmosphere. The seedlings in the HF treatment accumulated 275 ppm of F but showed no symptoms of injury. The phosphorus compounds were extracted with 0.6N trichloroacetic acid and separated on an anion exchange resin column by elution with a variable gradient of formic acid and ammonium formate. There were no apparent differences between the atmospheric treatments with respect to the approximately 20 phosphorus compounds in the plant extracts. These results suggest that under some conditions plants can tolerate appreciable fluoride without significant inhibition of enzymes that catalyze reactions of phosphorus compounds (Author's abstract)

08884

Katz, M.

EFFECTS OF CONTAMINANTS, OTHER THAN SULPHUR DIOXIDE, ON VEGETATION AND ANIMALS. In: Pollution and Our Environment: Conference Background Papers. Vol. 1, Montreal, Canadian Council of Resource Ministers, Paper A4-2-2, p. 1-18, 1967. 23 refs. (Presented at the National Conference, Canadian Council of Resource Ministers, Montreal, Oct. 31-Nov. 4, 1966.) Available from the Canadian Council of Resource Ministers, 620 Dorchester Boulevard West, Montreal, Canada.

It is apparent that air pollution can cause harmful effects on agricultural crops, and other species of vegetation. Apart from paper, the principal pollutants of serious concern are fluorides, ozone, photochemical smog products, ethylene and various aerosols occurring as suspended particulate matter. Gases such as chloride, hydrogen sulphide, oxides of nitrogen, and ammonia may constitute a hazard or cause damage to vegetation on occasion in localized areas. Suspended particulate matters consisting of small particles of smoke, sulphuric acid mist, soot and various metallic dusts, may be transported by wind for considerable distances from strong sources such as urban and industrial areas. These pollutants accumulate on leaf surfaces and clog the stomata to produce direct damage or retardation in growth. Unfortunately, there is a great lack of information on the extent of the damage to the Canadian economy

from the diverse effects of these pollutants on agriculture and forestry. Little, if any, coordinated research is being conducted in Canada on the biological effects of air pollutants on plants. Some studies have been conducted occasionally to meet the needs of a specific problem, such as the effects of ozone on tobacco. With regard to the harmful effects of air pollution on animal health, the evidence of major air pollution disasters points to adverse symptoms in animals of a character similar to those suffered by man. Animals in these episodes have suffered acute respiratory distress, bronchitis, emphysema and heart failure. Fluorides, arsenic and lead are highly toxic pollutants that may cause diseases in animals by accumulation in the forage and other crops that constitute the principal diet of cattle and other farm animals. There are many other pollutants derived from the incomplete products of combustion of fuels and from specific industrial processes that possess toxicological properties. However, animal research in this field is virtually non-existent in Canada. There is a great need for a broad, well-balanced research program to determine the biological effects of specific air pollutants and of simple and complex mixtures.

09553

Crampton, E. W.

HUSBANDRY VERSUS FLUORIDE INGESTION AS FACTORS IN UNSATISFACTORY DAIRY COW PERFORMANCE. J. Air Pollution Control Assoc., 18 (4):229-234, April 1968. 7 refs.

During 1965 and 1966 a critical study was made of the quality, condition, and performance of some 1000 dairy cows on 45 farms in four compass areas in the region centering on Arvida, Quebec, where an Aluminum Smelting operation emits effluent that results in a contamination of their forage of from about 10 to as high at times of 105 ppm fluoride. Cattle winter forage in this area is consistently poor in quality, partly because of the species that can be grown, but more importantly because of adverse spring climatic conditions which in many year prevent harvest of hay until the plants have fully matured and ripened. Its effective feeding value, measured by recorded voluntary consumption and in vivo digestibility, has been found to be about half that of high quality legume hay. Commercially prepared meal mixtures constitute the non -roughage portion of the winter rations fed, and these by analysis have been found individually to contain from 65 to 85 ppm fluoride contributed chiefly, and probably exclusively, by some form of rock phosphate included as a source of the necessary phosphorus supplement. The factors statistically examined in the study included: growthiness, size, fleshing, and milking cows; the incidence and degree of dental fluorosis, and skeleton accumulation of fluoride (by tail bone biopsy of 48 representative cows); the makeup and amounts of ration fed daily during the winter farm feeding; and the feeding and breeding management followed. The statistical procedures of variance and covariance, and of correlation and partial regression were computer analyzed. The results indicated that inadequacy of energy intake traceable largely to the nutritional nature of the hay fed was of significantly greater importance than any of the other factors recorded. Fluorine ingestion carried a statistical weight of only about 3 percent as a cause of the performance of the cattle. By difference it appeared that breeding and the generally unsatisfactory management of the cows, especially the feeding practice, was about twice as important as feed allowances as causes of the poor quality and performance of the cows. (The terms fluorine and fluorine and the symbol F are used interchangeably in this paper. Levels of fluorine are reported on the elemental basis.) (Author's abstract)

09683

Pack, Merrill R. and Donald F. Adams

EFFECT OF HYDROGEN FLUORIDE ON FRUITING OF BEANS. Washington State Univ., Pullman, College of Engineering, National Center for Air Pollution Control Contract AP-00341-04, 11A-3801-0815, Proj. 0815, Rept. 68/1-28, 8p., March 1968. 7 refs.

The response of bean fruiting to hydrogen fluoride fumigation was investigated in a series of experiments. The plants were exposed to various concentrations of HF, either for 7 to 14 days at different times relative to flowering or continuously from seeding to harvest. Hydrogen fluoride treatments averaging up to 8.0 micrograms F/cu m for 9 days and 7.8 micrograms F/cu m for 14 days applied before, during, or after flowering, had no apparent effects on fruiting of any of the four varieties of beans. Fruiting was not affected in four bean varieties continuouly fumigated at 2.2 micrograms F/cu m. Bean plants exposed continuously to HF at concentrations averaging 5.4, 6.6, and 13.9 micrograms F/cu m produced fewer fruit and/or fewer seeds per fruit than comparable control plants. Only Tendergreen beans were tested at 5.4 micrograms F/cu m. Tendergreen and Pencil Pod Wax varieties showed effects on fruiting at 6.6 micrograms F/cu m, but Red Kidney and Tendercrop varieties did not. Fruiting was affected in both bean varieties tested at 13.9 micrograms F/cu m (Red Kidney and Tendergreen). (Author summary modified)

10150

Weinstein, L. H., P. W. Preuss, and A.G. Lemmons

STUDIES ON FLUORO-ORGANIC COMPOUNDS IN PLANTS. I. METABOLISM OF (2)-14C-FLUOROACETATE . Contri. Boyce Thompson Inst., 24 (2):25-31, Jan.-March 1968. 17 refs.

The metabolism of (2)-14C-sodium fluoroacetate was studied in Acacia georginae, peanut, castor bean, and 'Pinto' bean. When this compound was supplied to sterile seddlings of these four plants, 14CO2 was evolved and 14C was incorporated into water- soljble fractions and lipids. Results indicate that the plants studied contain an enzyme system capable of cleaving the carbon fluorine bond. (Authors' summary)

10342

Tanaka, Yuichiro

EXPANDING POLLUTION IN ORCHARDS - DAMAGES ON ORANGES OF THE KAMBARA AREA BY FLUORIDE GASES. (Kadudai suru kajuen no kogai - fusso gasu ni yoru Kanbara chiho no mikankogai). Text in Japanese. Kajitsu Nihon (Japan. Fruits), 22(10):1-4, Oct. 1967.

Approximately 100,000 tons of aluminum per year are produced at the Kambara plant of the Japan Light Metal Co., with 1262 tons/year of gaseous emissions produced from solvents such as fluorspar and aluminum fluoride. Although gases from the electrolysis furnaces are emitted through stacks, a considerable amount escapes into the factory and is discharged through the windows and ceiling. Necrosis, chlorosis, and early leaf fall occurred to bamboo, plums, cherries, maples, and persimmon, in the same year operation began. Orange leaves were affected most severely, with the harvest of the following year drastically reduced. Shrinkage of the leaves and deterioration of the trees occurred, until eventually the trees lost their capacity for fruition altogether. Orange flowers are particularly vulnerable to gases. Fluoride enters into leaves through the pores and concentrates at the tips of the veins. The cell membranes are damaged after a certain concentration is reached, chloroplasts are destroyed, and eventually metabolism and physiological functions completely cease. Control

tests were conducted with a spray of lime sulfur mixture, fertilizers, and wind barriers. Wind barriers exerted a slight effect, but the problem was not entirely solved.

10673

Hill, A. Clyde

AIR QUALITY STANDARDS FOR FLUORIDE VEGETATION EFFECTS. Preprint, Utah Univ., Salt Lake City, Center for Environmental Biology, ((22))p., 1968. 34 refs. (Presented at the 61st Annual Meeting of the Air Pollution Control Association, Cleveland, Ohio, June 24-27, 1968, Paper 68-165.)

Facts that must be taken into consideration in developing fluoride standards for vegetation effects include: (1) Fluoride is an accumulative toxicant and injury is usually associated with long term exposure; (2) Gaseous and particulate fluorides differ in their phytotoxicity; (3) Plant species and varieties differ greatly in susceptibility to fluoride; (4) Extremely low concentrations can cause damage to sensitive species. Three possible approaches to standards are discussed: Atmospheric fluoride concentration, vegetation fluoride concentration, and the presence of leaf necrosis or chlorosis. Atmospheric fluoride concentration has the advantage that it fits the conventional concept of standards and that it is objective. Accurately measuring low fluoride concentration, separating gaseous from particulate fluorides in the air sample, and establishing a safe concentration present technical problems, however. Vegetation analysis may more closely represent fluorides available to affect the plant. The presence of significant amounts of fluoride-induced leaf necrosis (e.g. 3% of the leaf area) may be the most practical approach to standards for fluoride vegetation effects. Advantages are that the combined effects of the form of fluoride, species and varieties, and concentration-time relationships are all manifest in the factor that is measured. Relatively little time is required to examine the vegetation in a large area and only 2 or 3 surveys a year are required. (Author's abstract)

10711

Suttie, J. W.

AIR QUALITY STANDARDS FOR THE PROTECTION OF FARM ANIMALS FROM FLUORIDES. J. Air Pollution Control Assoc., 19(4):239-242, April 1969. 6 refs.

The ingestion of forage contaminated with inorganic fluorides from industrial sources constitutes an air pollution problem for domestic livestock. In cattle, the syndrome is characterized by dental and skeletal lesions, lameness, chemical evidence of increased fluoride ingestion, and effects on appetite and milk production in severe cases. The only practical basis for a standard appears to be one based on fluoride concentrations in forage. While a standard should protect cattle from loss of milk production and from severe dental fluorosis, it need not be set so low that the animals will be protected against any discernible deviations from normal which do not influence their general health, productive ability, or the soundness and wearing quality of their dentition. As there may be wide seasonal variations in forage fluoride concentrations, the basic standard should be expressed as a yearly average. However, as the developing teeth may be adversely influenced by short periods of high exposure, the standard should contain a provision which limits both the extent and duration of time that high concentrations may be tolerated even though they are balanced by lower values at other months. Based on these criteria, a tentative standard is proposed which limits forage fluoride to an average of 40 ppm, as well as the time that forage concentrations may exceed 60 or 80 ppm. (Author abstract modified)

10841

Bronsch, K. and N. Grieser

FLUORINE AND FLUORINE TOLERANCES IN FODDER OF DOMESTIC ANIMALS. 2. PATHOPHYSIOLOGY OF FLUORINE AND FODDER TESTS ON DOMESTIC ANIMALS. Berlin-Muench. Tieraerztl. Wochschr., 77(20):401-408, 1964. 297 refs. Translated from German by J. Chapin. National Institutes of Health, Bethesda, Md., Translating Unit, 23p., 1965.

The effect of fluorine on the animal organism is due mainly to resorption, fixation in hard tissues, and excretion interaction. Symptoms and experimental results are presented for acute, subacute, and chronic fluorine intoxication. Growth retardation must be included in the description of subacute fluorine intoxication. Morphological alterations in the bones and teeth are described for chronic fluorine intoxication. Animal experiments are critically assessed to determine how much fluorine can be tolerated without having an injurious effect on the animal. Important differences are noted between different types of animals with regard to dosage. In presenting the animal experiments, it is necessary to differentiate between indifferent and tolerable fluorine concentrations. The difference between these two terms is based on the fact that in those animals which receive tolerable fluorine concentrations during dental formation, slight changes can occur in the teeth. However, this mottling leads neither to an increased abrasion of the teeth nor other damages. Metabolic disturbances, among which are included changes of the tooth structure, occur only at higher fluorine concentrations. It is also necessary to distinguish between poorly and readily soluble fluorine compounds. The tolerance of fluorine depends on the mineral supply of the animals, especially with calcium and phosphorus. A deficiency of one or both of these minerals results in a sensitivity toward fluorine.

10843

Grieser, N. and K. Bronsch

FLUORINE AND FLUORINE TOLERANCES IN THE NUTRITION OF DOMESTIC ANIMALS. 1. BEHAVIOR OF FLUORINE IN METABOLISM. Berlin Muench. Tieraerztl. Wochschr., 77(19):373-379, 1964. 298 refs. Translated from German by A. A. Vildzius. National Institutes of Health, Bethesda, Md., Translating Unit, 19p., 1965. (References included in Aptic 10841.)

The most important facts concerning the toxicity of fluorine compounds are compiled and evaluated critically, with particular reference to the tolerated doses of F in the nutrition of domestic animals. Fluorine metabolism, its resorption, and distribution in the blood and tissues are considered. Excretion ratios are indicated. Effects of fluorine on calcium metabolism, enzymes, organ function, and symbionts are discussed. The toxic effect of fluorine can be explained essentially by enzyme inhibition.

11100

Abeles, F. B., and H. E. Gahagen, III

ABSCISSION: THE ROLE OF ETHYLENE, ETHYLENE ANALOGUES, CARBON DIOXIDE, AND OXYGEN. (TECHNICAL MANUSCRIPT.) Dept. of the Army, Frederick, Md., Plant Sciences Lab., Proj. 1B522301A061, TM-462, 15p., June 1968. 25 refs.

For beans, ethylene was the most effective abscission accelerant examined, with decreasing activity shown by propene, carbon monoxide, dioxide, acetylene, vinyl fluoride, 1-butene, and 1,3-butadiene. Carbon dioxide inhibited abscission, but its effect was overcome by ethylene. Oxygen was required for ab-

scission as an electron acceptor for respiration and not as a potentiator or activator of the ethylene attachment site. The molecular requirements for abscission were similar to those shown by other workers for other biological processes under the influence of ethylene. (Authors' abstract)

11157

Agriculture Research Council, London (England)

THE EFFECTS OF AIR POLLUTION ON PLANTS AND SOIL. 53P., 1967. 202 refs.

An account of recent trends in the emissions and concentrations of smoke, deposited matter and sulphur dioxide in Britain and summa- rises the information available on the effects of these pollutants on plants and soil is given. The literature on the effects on plants and soil of fluorides and of photochemical, or oxidant, smog which some people think might be troublesome in this country in the future. A note on the contamination of plants near highways with lead from the exhaust fumes of motor vehicles is also included.

11407

C.R. Thompson, O.C. Taylor

EFFECTS OF AIR POLLUTANTS ON GROWTH, LEAF DROP, FRUIT DROP AND YIELD OF CITRUS TREES. Preprint, California Univ., Riverside, Statewide Air Pollution Research Center, ((31))p., ((1968)). ((17)) refs.

Commercially producing lemon and navel orange trees were studied to determine the effects of the air pollutant complex, especially photochemical oxidants and fluorides, in the Los Angeles Basin on the following responses: growth as shown by increased tree girth and weight of prunings; leaf drop as measured by (a) total weight of dried leaves collected under the trees, and (b) the time which marked leaves remained on randomly selected branches; fruit drop; and yield of mature marketable fruit. The results showed that tree growth measured by increased girth and weight of pruning removed were not affected consistently by the experimental treatments. The rate of leaf drop was significantly less for lemon trees where carbon filtered air was supplied to the trees versus the unfiltered treatments. A similar trend was present in oranges but was not significant statistically. The percent of lemon leaves which remained on selected branches of trees receiving filtered air as compared to unfiltered treatments after 18 months was 72.4 vs. 34.4%. Fruit drop in lemons is of minor significance but in navel oranges represents a serious problem. Comparisons of check trees, unfiltered and carbon filtered air trees showed fruit drop to be 82.5, 59.7, and 39.6, respectively, all percents of which are statistically different at the 1% level. Yield of marketable fruit is also reduced significantly by photochemical oxidants. (Authors' abstract, modified)

11452

Cohrs, F.

SICKENING OF DOMESTIC ANIMALS THROUGH SMOKE DAMAGE AND INDUSTRIAL WASTE WATER. ((Erkrankungen der Haustiere durch Rauchschaeden und Abwaesser der Industrieanlagen.)) Translated from German. Monatsh. Veterinaermed., 11/2):662-669, 1956. 77 refs.

The effects of industrial smokes containing sulfur compounds, arsenic compounds, lead, copper, fluorine, molybdenum, zinc, and selenium on domestic animals are reviewed. The most frequent intoxications result from lead, arsenic, SO2, and fluorine. Fluorosis has gained considerable importance in the last 30 years and today represents the most important disease among the smoke injuries. Pneumoconiosis very seldom develops in animals as a results of flue ash. Clinical manifestations and pathological anatomy, the course of disease, the changing picture of the disease manifestations, and meteorological and topographic influences are discussed. Mechanical, chemical and physical effects of smoke are also considered.

11456

Ferro, O.

ESTIMATING DAMAGES FROM TOXIC GASEOUS EFFLUXES. ((Stima di danni da emanazioni gassose tossiche.)) Translated from Italian. Agric. della Venezie, Vol. 14, p. 364-383, 1960.

The estimation of damages caused by toxic effluents is illustrated in the case of seven agricultural claimants against a glass factory emitting fluorine compounds. The decay of topsoil, diminished or lack of production of the plantations, and damage to cattle through the ingestion of polluted fodder are basic criteria used in the evaluation. The nature of damage (including amounts of fluorine found) is discussed in detail. The estimation of indemnities (e.g. value of dead plants) for each of the seven claimnants is outlined. Technical devices aimed at eliminating these emissions are briefly discussed.

11466

Bohne, H.

INDUSTRIAL SMOKE DAMAGE FROM FLUORIDE. ((Industrielle Rauchschaden durch Fluor.)) Translated from German. Mitt. Deut. Landwirtsch. Ges. (Frankfurt), 77(17):575-578, 1962.

The damage caused to plants and animals by air containing fluoride was investigated, and the extent of this damage and its economic importance evaluated. Damage to plants usually takes the form of discoloration of leaves. Chemical analyses were performed to determine the extent of cumulation of fluorine in cereals, truck crops and fodder plants, pastures, fruit trees, garden and decorative plants, and forest trees. The green portion of pear leaves gathered contained 8.5 percent fluorine, and the brownish edge of the leaves, 21.2 mg percent fluorine, illustrating that the discoloration was due to the effect of fluorine. Fluoride emissions exert quite evident damage on cattle. The animals eat contaminated fodder, grass, and hay, and also inhale quantities of fluorine. This explains why these animals suffer more in comparison to animals kept constantly in stables. The external symptom of such effects is a yellow to dark brown discoloration of the incisors, whose enamel sometimes breaks off. Increased deposition of fluorine in the bones sometimes results in stiff hobbling and painful walking. Chemical analysis proves that animals showing whese symptoms of fluorine exposure have in their organism too much of this substance. These symptoms were also observed in hogs who were allowed to eat in pastures. Cattle show a reduction in the formation of milk and they conceive poorly as a result of fluoride emissions.

11469

Liegois, F. and J. Derivaux

SOME CASES OF CHRONIC FLUOROSIS IN SHEEP. ((Quelques cas de fluorose chronique chez des moutons.)) Translated from French. Annales de Medecine Veterinaire, 100(5):221-224, 1956. 63 refs.

Clinical observations of several sheep with chronic fluorosis in Belgium are discussed in detail. The observations are compared with those of several other authors. Numerous examinations of the blood, particularly studying the total calcium, inor-

ganic phosphorus, phosphatases and in some cases magnesium, polypeptides, urea, cholesterol, proteins, serum albumins and globulins, and glucose were made. Autopsy of these animals showed no specific characteristics, other than bone lesions and especially dental lesions. The limit safe dose of fluoride that a cow can absorb daily over a long period of time was investigated. No delayed growth or weight gain, or alteration in the general condition and hooves of lactating cows receiving 2 to 3 mg of fluorine in the form of natural phosphates, was observed.

11650

Gottfried Halbwachs, and Josef Kisser

DWARFISM IN FIRS AND BIRCHES CAUSED BY SMOKE IMMISSIONS. ((Durch Rauchimmissionen bedingter Zwergwuchs bei Fichte und Birke.)) Translated from German. Centralblatt fur das gesamte Forstwesen, 84(2-6):156-173, 1967. 34 refs.

A morphological and anatomical study of dwarfed varieties of Norway spruce and birch was made. The varieties became established under the chronic influence of polluted air containing HF from an aluminum plant. A possible effect of minerals or water in the soil was excluded. The spruce specimen examined was 20, the Birch, 18 years old. The trees have a shrub-like, bushy appearance. This is due to the fact that the terminal shoot of the spruce fades out when it grows beyond a certain height, then occasionally the buds from the lateral twigs start to develop. The shape of the dwarfed birch is caused by the elongation of basal buds. The size of the needles and leaves is greatly reduced particularly on the weather side. The reduction is due to a decrease in number as well as size of the cells. The number of pith ray cells per unit area is increased as compared to normally developed spruce trees. With birch no different reaction was found. It is open for further investigation if this observation indicates a fundamentally different reaction iof dwarfed soft- and hardwood.

12032

J. Y.-O. Cheng, M.-H. Yu, G. W. Miller, and G. W. Welkie

FLUOROORGANIC ACIDS IN SOYBEAN LEAVES EXPOSED TO FLUORIDE. Environ. Sci. Technol., 2(5n8:367-370, May 1968. 17 ref.

Soybean plants were fumigated with HF or grown in nutrient solution containing sodium fluoride or fluoroacetate, and the organic acid fractions of the leaf extracts were compared. Organic acid extracts from these treatments contained fluoroorganic compounds that were chromatographically similar to fluoroacetate and fluorocitrate. The fractions suspected of containing fluorocitrate were separated from HF- and NaF-treated leaf extracts and found to inhibit aconitase prepared from either pig heart or soybean leaves. The inhibition was similar to that exhibited by commercial fluorocitrate. Aconitase from soybean leaves was as sensitive to fluorocitrate as that isolated from pig heart. Fluorocitrate was identified in extracts of fluoride-treated plants by infrared spectroscopy. (Author's Abstract)

12042

Heggestad, H. E.

DISEASES OF CROPS AND ORNAMENTAL PLANTS INCITED BY AIR POLLUTANTS. Phytopathology, 58:1089-1097, Aug. 1968. 80 ref.

Air pollution injury to crop and ornamental plants is increasing in the U.S.A. Estimates of annual losses to agriculture from air pollutants, which ranged from $150 to $500 million during the decade 1951-1960, are now $500 million. Although most of the loss is due to growth suppression or chronic injury, it is the acute injury that suggests the nature of the air pollutant and reveals the distribution of the problem. Each pollutant tends to produce its own pattern of injury, leaving graphic records of air pollution episodes. Photochemical oxidants, ethylene, sulfur dioxide, fluoride, and other pollutants produce marked reactions in various types of plants. The recent developments and current research trends in the assessment of these reactions are reviewed.

12045

Johnson, H.

THE HIGH COST OF FOUL AIR. The Progressive Farmer, 4 pp., April 1968.

The President's Science Advisory Committee reported in 1965 that air pollution damage to plants had been observed in 27 states, the District of Columbia, Canada, and Mexico. Total damage each year to crops in the United States is estimated at $500 million. Weather fleck damage to tobacco, which is caused by ozone, has caused substantial crop loss in all producing states. Sulfur dioxide, fluorine, ethylene, and photochemical smog are known to be harmful to plants. A research program to solve unanswered questions, and a program to enforce the cleaning up of pollution sources is urgently needed.

12155

Leone, Ida A., Eileen Brennan, and R. H. Daines

EFFECTS OF AIR POLLUTION ON VEGETATION. Preprint, Air Pollution Control Association, New York City, 6p., 1962. (Presented at the Air Polltuion Control Association, Mid-Atlantic States Section Meeting, Wilmington, Del., Oct. 26, 1962.)

Phytotoxic pollutants are broadly catergorized as primary or single source emissions and the products of photochemical reactions arising from urban expansion and vehicular traffic. Among the primary contaminants, classified according to their demonstrated order of toxicity to plants, are hydrogen fluoride, chlorine, sulfur dioxide, ammonia, and hydrogen sulfide; to these may be added ethylene and perhaps natural illuminating gas. The acute and chronic types of injury caused by S02, the earliest known offender, and by hydrogen fluoride are described. The latter is the most insidious of the phytotoxic pollutants, since it is injurious to certain sensitive species at fractions of a part per billion. The two most significant pollutants from photochemical reactions are ozone, which generally attacks the upper leaf surface of sensitive plants, and oxidized hydrocarbons. The chief offender of the oxidized hydrocarbons is peroxyacyl nitrate and its analogues. Plant injury from specific pollutants can be diagnosed by particularly susceptible species or indicators, by type of symptom, and by significant emission sources in the vicinity. Air quality and meteorological data from three New Jersey communities - Carlstadt, New Brunswick, and Bordentown - are briefly reviewed in relation to phytotoxic episodes. Possibe control measures in combatting pollution damage to plants include anti-oxidant sprays and the breeding of resistant plant varieties.

12415

Brandt, C. Stafford

EFFECTS OF AIR POLLUTION ON CROP PRODUCTION. Preprint, 11p., 1967. (Presented at the Ontario Pollution Control Conference, Toronto, Dec. 4-6, 1967.)

The contamination of vegetation by atmospheric sulfur dioxide and fluoride and by phytotoxicants associated with

photochemical smogs is discussed. Identifiable plant injuries are summarized and a distinction is made between plant injury and damage. The former is considered to refer to the symptom or the respose; the latter, only to the effect of the symptom or response on the desired use of a plant. In the case of sulfur dioxide, acute injury occurs whenever the atmospheric concentration at the leaf exceeds a certain threshold value. As long as the concentration stays less than this threshold, acute injury does not occur. Chronic injury may occur in time. This type of injury is almost impossible to identify with certainty in the field. The easiest description is that of premature senescence, a phenomena that is becoming more and more common in many areas. In the case of fluoride, atmospheric concentrations are of little importance, but the amount accumulated in the tissues is important. When the concentration exceeds certain values, acute symptoms develop. There is no recognizable chronic-type injury due to fluoride. A 10 to 12% reduction of plant productivity along the eastern seaboard is predicted as the result of air pollution in general and photochemical smog in particular.

12529

Bardelli, P. and C. Menzani

STUDIES OF SPONTANEOUS FLUOROSIS IN RUMINANTS: A NOTE ON PROPHYLAXIS. ((Ricerche sulla fluorosi spontanea dle ruminanti: Nota preventiva.)) Text in Italian. Annali d'Igiene, 45(6):399-404, 1935.

The opening of an aluminum refinery near a silkworm breeding region resulted in the destruction of silkworms on an increasing scale as the plant increased its operations. Investigations showed that the cause of death among the silkworms was the ingestion, along with the mulberry leaves, of fluorine discharged into the air by the plant. In the same region, but somewhat later, the following effects were noted in cattle: malnutrition, lower milk yield, and persistent lameness. Still later, goats in the region developed the same symptoms. From an examination of the relevant literature, the authors concluded that the above-described symptoms were instances of fluorosis or fluorine cachexia, of the type reported among animals living near superphosphate or aluminum plants. In a controlled experiment the authors found that three cows and two goats who received 0.38 to 1.8 g fluorine per day developed clinical fluoroses identical to the spontaneous form, whereas the controls did not.

12533

Hupka, E. and Luy, P.

FREQUENT OCCURRENCE OF OSTEOMALACIA AMONG GRAZING CATTLE CAUSED BY HYDROFLUORIC ACID CONTAINED IN THE FLUE GAS DISCHARGED BY A CHEMICAL PLANT. ((Gehauftes Auftreten von Osteomalacie unter Weiderindern, verursacht durch Fluorwasserstoffsaure enthaltenden Fabrikrauch.)) Text in German. Arch wissenschaftliche praktische Tierheilkunde (Berlin), 60:21-39, 1929. 12 refs.

In the year 1928 a number of animals grazing in the vicinity of a chemical plant fell ill to a disease which was diagnosed as fluorosis. But the symptoms shown by the diseased animals were in many respects different from those commonly associated with such cases. The two front legs became lame, toes and ankles were swollen. The pulse rate was higher, an increased body temperature was measured and pain was felt. In some cases the hind legs became stiff. Furthermore an enormous loss of weight was observed and swellings appeared along the ribs. The milk production decreased. All these symptoms indicate osteomalacia. The grass on which these animals fed was examined but it was found lush and in no way lacking in Ca and phosphoric acid (osteomalacia is a deficiency of these two minerals). The toxicant was found to be the fluorine deposited on the grass and plants. Hydrofluoric acid attacks the calcium in the bones and dissolves it which means that the calcium is constantly reduced. The consequence is osteoporosis. The fluorine is discharged with the flue gas of the nearby chemical plant. The disease did not occur outside the range of the chemical plant. The condition of the animals visibly improved during winter time when they were fed with fodder coming from an unpolluted area. The animals were treated with nephritine which relieved them of their pain. The chemical physiological examinations which were conducted showed that the calcium of the bones is used to neutralize the hydrofluoric acid. The by-product of this neutralizing process, phosphoric acid, is discharged with the urine.

12538

Narozny, J.

DENTAL FLUORISIS OF CATTLE. ((Dentalna fluoroza hovadzieho dobvtka.)) Text in Slovak. Veterinarni Medicina 7:421-424, 1965.

The syndrome of dental fluorosis was used for evaluation of the toxic effect of fluorine exhalates from a Slovak aluminum-producing factory, and of the territorial area thus contaminated. During 1964, 5,320 animals from 31 localities of the examined region were investigated. The findings were evaluated in accordance with Dean's 5-grade classification system which proved fully relevant to the experimental conditions selected. The emissions were found to be air-flown mainly in two directions and they affected the territory up to 16 km from the source of emission. The examined area was divided into five classification zones and the occurrence of dental fluorisis was evaluated and tabulated for each of them. The results indicate that unusual wear and abrasion of teeth, due to acute dental fluorisis, unfavorably affect the life span of cattle regardless of the fact that cattle can develop a certain adaptability to the fluorine compounds.

12540

Pavlovic, R. A. and Bogdanovic, S. B.

CALCIUM AND PHOSPHORUS IN RABBIT BLOOD SERUM FOLLOWING SODIUM FLUORIDE POISONING. ((Le calcium et le phosphore du serum sanguin chez le lapin apres l'intoxication par le fluorure de sodium.)) Text in French. Compt Rend., Soc. Biol (Belgrade). 109:475-477, 1932. 3 refs.

The process involved in sodium fluroide poisoning is of interest in both the toxicology and the general pathology of bone and articulation sicknesses. We know little about the part played by fluorine in rachitis. Certain substances important in bone pathology have been determined in the blood, but the results obtained have not been interpreted. The initial weight of the rabbits used ranged between 1350 and 2200 gr. Calcium and phosphorus were determined in the blood serum before and after poisoning by injections of a 1% solution of sodium fluoride. Chronic poisoning was produced by daily injections increasing from 10 to 30 mgr of solution per animal kg over a period of 105 to 121 days. This caused calcium to diminish from 17.6 to 14.5 mgr per 100, and phosphorus to fall from 7.4 to 6.3 mgr per 100, against 18.1 to 17 and 9.6 to 6.3, respectively, in control animals. Acute poisoning was produced by a single injection of 60 mgr per animal kg. This caused the calcium to diminish from 16.6 to 14.7 mgr per .00, and phosphorus to fall from 7.3 to 5.5 mgr. No change was found in the control animals.

12551

Cristiani, H.

CHANGES IN THE THYROID GLAND UNDER FLUORIC POISONING. ((Alterations de la glande thyroide dans l'intoxication fluoree.)) Text in French. Compt. Rend. Soc. Biol. (Paris), 103:554-557, 1930.

Thyroid gland changes are studied in animals subjected to chronic poisoning by ingestion of small doses of alkaline fluorides or fluorsilicates. Because goiters are frequent in this area of the country, control animals were included in the experimental groups. Test results on 14 fluorinated animals (guinea-pigs) are tabulated. Death occurred in 19 to 94 days (average 53). All animals showed changes in the gland, the interstitial tissue. The changes here were rapid, but may be slower with smaller doses. All control animals were found to be healthy. Macroscopic changes in the pituitary body in cases of fluorosis. The different endocrine glands react differently to fluoric poisoning. The pituitary gland is difficult to study because this gland varies with age, sex, pregnancy, etc. of the subject. Use was therefore made of adult guinea-pigs 6 to 8 months old, which had died of fluoroxix. Their pituitary body was compared to that of control animals of the same age and sex. Results are tabulated, showing a shrinking of the gland in the test animals, mostly in the nature of a flattening 2.25 mm (normal average) to an average of 1.7 mm (after poisoning).

12552

Cristiani, H. and R. Gautier

FLUORIDE EMANATIONS FROM FACTORIES: EXPERIMENTAL STUDY OF THE ACTION OF FLUORINE PLANTS. ((Emanations fluorees des usines: etuded experimentale de l'action du fluor sur les vegetaux.)) Text in French. Ann. Hygiene Publ (n.s.), 3:49-64, 1925. 17 refs.

Research work from 1883 onward and the authors' own experiments on the damages done to plants by fluoric emanations from aluminum and/or chemical fertilizer factories are reviewed. Fluoric compounds may act through the soil and water that feed the plants, or directly on the plant organs exposed to fluorine-polluted air. Of the various toxic gases, hydrofluoric acid is the most noxious since it forms thick fogs with the humidity in the air. The effects are cumulative and may not become visible before repeated exposure of the plants to the gases. The toxic action of NaF derives from its ability to precipitate lime and to attach itself to other substances, such as proteides. Also, fluorine salts have antiseptic action on unicellular elements, and this has had practical applications. At the doses utilized, alkaline salts of fluorine do not precipitate albumin, and can hamper microbial growth without harming soluble ferments. On the other hand, examination of plant lesions enables the detection of their fluoric, as opposed to other (sulfur, chlorine....) origin. Stoklasa claims that the amount of emanation and smoke has increased 100-fold in the last century, reducing the crops in some regions by 30 to 90%. The work on fodder from industrial areas was confirmed by experiments with fluorine compounds in air and in water.

12553

Cristiani, H. and R. Gautier

EXPERIMENTAL RESEARCH ON THE TOXICITY OF FODDER HARVESTED IN THE VICINITY OF AN ALUMINUM-PRODUCING FACTORY. ((Recherches experimentales sur la toxicite des fourrages recoltes dans le voisinage d'une usine productrice d'aluminium.)) Text in French. Ann. Hygiene Publ., Ind. Sociale, 4:141-154, 1926. 7 refs.

Experiments were made from 1919 to 1924 on guinea-pigs whose diet contained, in part, fodder exposed to the emanations of an aluminum factory. The animals died after a time that depended on the amount of fluorine present in the fodder. Death was preceded by cachexy and symptoms similar to those exhibited by cattle in areas around the same factories. Test results are tabulated. The fodder must contain more fluorine than normally present in such plants. These conditions were obtained around the subject factory, during intense production only. A second set of tests were made on fodders artificially altered by gases containing fluorine. The results were similar to those described above and showed that other gases than fluorine, which may additionally have altered the fodder, are not necessary for the production of the disease.

12554

Ehrlich, C.

OBSERVATIONS AND INVESTIGATIONS OF CHRONIC FLUORINE POISONING IN CATTLE. ((Beobachtungen und Untersuchungen uber chron. Fluorvergiftungen bei Rindern.)) Text in German. Deut Tieraerztl. Wochschr., 61:225-228, June 1954.

Fluorine poisoning of cattle grazing in the vicinity of an aluminum plant was observed which lead to extensive clinical, pathologic-anatomical, bacteriological, serological and parasitological examinations. The clinical symptoms shown by the diseased animals were loss of weight, retardation in the development of young cattle, lusterless skin, stiff and pain-stricken movement, swollen ankles, impaired fertility of female animals, brown and black colored teeth which became loose and exostoses at the jaw bones and ribs. Sometimes a difficulty in breathing developed with the pulse becoming weak and irregular. A closer investigation of the deformed ribs showed that at the sites of the exostoses, the bones could be cut through very easily. No parasitic or bacteriologic ailment was found in the animals. The chemical analysis yielded a high fluorine content in the teeth and bones which was on the average one to ten times as high as with healthy animals. The increase of the normal fluorine contents was lowest in the blood and highest in teeth, bones, claws and in the urine. To answer the question of how these toxic fluorine compounds entered the body, samples of the grass and soil in the vicinity of the aluminum plant (up to a diameter of 2 km) were examined. The fluorine contents of these samples was 31 to 56 times higher than of samples taken outside the range of the plant. Thus the animals consumed the fluorine with the fodder which was intoxicated either by fly dust and/or by nourishing on a soil rich in fluorine.

12556

Gerschmann, Rebeca

PARATHYROID AND FLUORIC HYPOCALCEMIA. ((Parathyroide et Hypocalcemie Fluorique.)) Text in French. Compt Rend Soc. Biol. (Paris), 104:411-412, 1930

The tests on dogs here described show that the parathyroids tend to maintain the calcemic level at its normal value, contributing to raise it when it otherwise may fall. Sodium fluoride served as hypocalcemic agent, injected intravenously (30 mg per kg animal weight). Calcium was measured in the blood serum, phosphates in the plasma, chlorides in the whole blood. In normal dogs, the calcium level ranged from 11 to 10.7 mg per 100 cc. After surgical removal of thyroid/parathyroid glands, the level dropped in 48 hours from 10.5 to 5.9 mg, with most of the animals falling into tetany. The injection in normal dogs produced hypocalcemia with a drop of 3.3 mg in 2 hours and then a gradual recovery to near-normal level after

24 hours; inorganic phosphates increased from 3.2 to 5 mg; chlorides showed no regular changes. The same injection in dogs deprived of the glands caused a greater drop in calcium, yet smaller than the sum of the drops caused separately by the fluoride and the parathyroidectomy. But the lowered calcium level does not recover: the recovery seems to be due mostly to the operation of the parathyroidic function.

13159

Ferrando, R. and G. Milhaud

THE BIOLOGICAL EFFECTS OF AIR POLLUTION OF ANIMALS. (Effets biologiques de la pollution atmospherique sur les animaux). Text in French. Rev. Hyg. Med. Soc., 17(3):295-306, 1969. 2 refs.

Air pollution has many effects on animal organisms. Fluorine by-products, lead, and molybdenum are the major offending constituents in industrial air pollution. Cement dust and sulfur dioxide cause less of a problem. Pollution of agricultural origin is essentially linked to the more or less controlled use of pesticides. A temporary imbalance of natural fauna is most often indicated when domestic animals are victims of atmospheric pollution. The damage caused to livestock by this pollution will remain localized and its economic consequence will be relatively unimportant. The social consequences of this pollution are more severe, and it is as important to preserve the social climate as the health of the animals. The solution to these problems has long been in the hands of lawyers. Though indirect, the risk to the food cycle is serious. It will be necessary to institute strict tests for determining the amount of residual pollutants able to exist in food destined for men and to regulate the use of products absorbing these pollutants.

13203

Lezovic, Jan

THE INFLUENCE OF FLUORINE COMPOUNDS ON THE BIOLOGICAL LIFE NEAR AN ALUMINUM FACTORY. Fluoride Quarterly, J. Intern. Soc. Fluoride Res., 2(1):25-27, Jan. 1969.

Quantitative and qualitative analyses of tissues, milk, and teeth, along with fluoride level determination of bones, show that animal and vegetable life near an aluminum factory is adversely affected by fluoride emissions. The factory is located in a mountain valley, within 300 meters of the nearest village. All trees examined showed a marked increase in the fluoride levels of their leaves or needles. The leaves of exposed fruit trees were harder, glossier, more fragile than normal, and covered with a whitish-gray crust. Similar changes occurred on leaves of garden vegetables, especially cabbage, turnips, and cucumbers. Fruit on trees was visibly deformed. The first signs of damage to animal life occurred two years after the factory went into operation, when about 95% of the goats and cattle were afflicted with fluorosis. Swine, horses, and poultry were less sensitive. The weight of the affected cattle gradually decreased to the point of cachexia. Calcium and phosphorous levels in the blood of the diseased animals averaged, respectively, 7.5 and 5.06 mg%. As an indicator of damage, fluoride deposits on snow were of the order of magnitude of 15 to 234.8 mg/sq m.

13213

Allcroft, Ruth and K. N. Burns

ALLEVIATION OF INDUSTRIAL FLUOROSIS IN A HERD. Fluoride Quarterly, J. Intern. Soc. Fluoride Res., 2(1):55-59, Jan. 1969. 2 refs.

To determine the alleviating effect of aluminum and calcium in fluorosis, a herd of 24 Ayrshire cows was exposed to airborne fluoride and divided into three groups. One group was given supplements of aluminum sulfate, another aluminum sulfate plus calcium carbonate and anhydrous sodium phosphate. The third group was used as control. Urinary fluorine excretion, skeletal fluoride accumulation, and the general health of the animals were evaluated. Aluminum sulfate reduced bone fluoride storage by 22% in comparison with controls. The calcium phosphorous supplement did not enhance the effect of aluminum sulfate alone. However, it appeared that fluoride accumulation was merely delayed and storage to undesirable levels could not be prevented by the aluminum sulfate treatment. (Author summary modified)

13247

Mohamed, Aly H.

CYTOGENETIC EFFECTS OF HYDROGEN FLUORIDE ON PLANTS. Fluoride Quarterly, J. Intern. Soc. Fluoride Res., 2(2):76-84, April 1969. 8 refs.

Studies on the effects of hydrogen fluoride on meiotic chromosomes of tomatoes indicated a trend toward a higher frequency of chromosomal aberrations with an increase in the fumigation period. Hydrogen fluoride was shown to induce paracentric inversions with the possibility of deficiencies, duplications, or even translocations. The progeny of the treated plants, produced a number of abnormal phenotypes the same as, or similar to, known mutants. Further studies in maize microsporocytes for plants treated with HF confirm the cytological data reported for tomato plants. They offer clear evidence of inversions, translocations, and deficiencies. The results suggest that HF affects DNA synthesis by blocking, directly or indirectly, the replication of the DNA molecule. (Author summary modified)

13474

Yopp, J. H., W. E. Schmid, and R. W. Holst

DETERMINATION OF MAXIMUM PERMISSIBLE LEVELS OF SELECTED CHEMICALS THAT EXERT TOXIC EFFECTS ON PLANTS OF ECONOMIC IMPORTANCE IN ILLINOIS (FINAL REPORT). Southern Illinois Univ., Carbondale, Illinois Inst. for Environmental Quality Proj. 10.022, Rept. 74-33, 281p., Aug. 1974. 525 refs. NTIS: PB 237654

A literature search on the toxic effects of various pollutants on plants of economic importance in Illinois is presented. The occurrence, uptake and accumulation, toxicity and toxic tolerances, visible effects, and economic consequences are outlined for aluminum, barium, beryllium, boron, bromine, cadmium, ethylene, chlorine, chromium, copper, fluorine, lead, manganese, mercury, molybdenum, nickel, nitrogen dioxide, peroxyacetyl nitrate, ammonia, nitrate, ozone, sodium, sulfur dioxide, sulfates, hydrogen sulfide, thallium, vanadium, and zinc. The degree of plant injury as a function of the source of the phytotoxic agent is also discussed. Recommendations for maximum permissible levels are given for both airborne and soil forms of the pollutants where possible.

13804

De Cormis, L. and G. Viel

STUDIES CONCERNING THE EFFECTS OF POLLUTINGS ON CROPS. (Etudes concernant les effets des pollutants sur les cultures). Text in French. Rev. Hyg. Med. Soc., 17(3):307-312, 1969.

Damage to crops and vineyards in certain areas of the Basses-Pyrenes was attributed to pollutants emitted by the industrial

complex at Lacq, particularly to the sulfurous gas discharged by a desulfurization plant. Air measurements revealed the presence of SO2 in the neighborhood of the factories and strong intermittent pollution at distant points. However, necrosis was observed on plants relatively resistant to SO2-induced injuries and plant damage in the area of the factories is attributed to atmospheric fluoride components. In other areas, fluoride levels were not high enough to explain the necrosis. Laboratory studies indicate that fluoride and sulfur are normal components of plant tissues, so their presence is not a factor in determining pollution. Plants, especially apricot trees, are indicators of fluoride pollution. The acidity of rainwater cannot be assumed to have a direct relationship to plant damage. In controlled atmospheres, plants were enriched by subtoxic quantities of sulfur and fluorine. However, sulfur is metabolized by plants while fluoride is accumulated and can attain toxic levels.

13985

Shupe, James L.

LEVELS OF TOXICITY TO ANIMALS PROVIDE SOUND BASIS FOR FLUORIDE STANDARDS. Environ. Sci. Technol., 3(8):721-726, Aug. 1969.

Fluorosis, a disease common to cattle, occurs when fluorine compounds are ingested for long periods of time. Hydrogen fluoride and silicon tetrafluoride are two phytotoxic gases encountered in air pollution which may accumulate on the vegetation eaten by livestock. There are no adverse effects on dairy cattle when the fluorine content of the daily ration is less than 30 ppm, while 40 to 60 ppm will result in moderate adverse effects. Acute fluorosis results from ingestion of 250 ppm fluoride and is characterized by stiffness, anorexia, weakness, high blood and urine flouride, convulsions, and cardiac failure. Chronic fluorosis is typified by ingestion of 60 to 100 ppm fluorine/day, by severe dental malformations, and by bone lesions. Fluorine toxicity can be alleviated by administration of aluminum sulfate, aluminum chloride, or calcium carbonate, but the necessity for regulation of fluorine content in air water, food products, and soil is acute. A discussion by L. V. Cralley and John P. Jewell is included.

14121

Ross, Cleon W., Herman H. Wiebe, Gene W. Miller, and Rex L. Hurst

RESPIRATORY PATHWAY, FLOWER COLOR, AND LEAF AREA OF GLADIOLUS AS FACTORS IN THE RESISTANCE TO FLUORIDE INJURY. Botan. Gaz., 129(1):49-52, 1968. 13 refs.

Leaf disks from 36 varieties of gladiolus were supplied with either 1-C-14-labeled glucose or 6-C-14-labeled glucose. Ratios of C6/C1 were determined and correlated with the fluoride sensitivity ratings reported by Hendrix and Hall. Leaves of varieties which were sensitive to hydrogen fluoride generally had a higher C6/C1 ratio than leaves of varieties resistant to fluoride injury. The results provide circumstantial in vivo support of the hypothesis that the primary fluoride injury mechanism in intact leaves involves the inhibition of enolase. Resistant varieties may be somewhat more dependent on the pentose phosphate pathway and less dependent on the glycolytic pathway than sensitive varieties. (Author abstract modified)

14247

Treshow, Michael and Frances M. Harner

GROWTH RESPONSES OF PINTO BEAN AND ALFALFA TO SUBLETHAL FLUORIDE CONCENTRATIONS. Can. J. Botany, vol. 46:1207-1210, Oct. 1968. 12 refs.

A study was conducted to determine whether sublethal doses of fluoride impaired or stimulated the growth of Pinto bean and Ranger alfalfa plants. When bean plants were fumigated with fluoride, growth was accelerated and internode development was conspicuously greater than in control plants. Fresh and dry plant weights were positively correlated with increasing fluoride content of the leaves. Statistically significant correlation coefficients of 0.91 and 0.98 were calculated between fluoride content and fresh and dry weights, respectively. When fluoride content exceeded approximately 200 ppm, weights decreased below those of the controls. Leaf chlorosis did not develop until foliar fluoride concentrations exceeded approximately 500 ppm. Fluoride sometimes stimulated growth of alfalfa, but results were inconsistent and no statistically significant relation existed between foliar fluoride content and plant weight. However, dry weight of fumigated plants whose foliar fluoride content exceeded 500 ppm was only 63% that of the control plants. No chlorotic or necrotic markings were observed on fumigated alfalfa plants. An understanding of the mechanisms for fluoride stimulation requires further investigation into morphological responses. (Author abstract modified)

14678

Hadjuk, Juraj

REACTION OF SOME RELATIVELY RESISTANT PLANTS TO SUDDEN INCREASE IN THE CONCENTRATION OF FLUORINE EXHALATIONS. (Reakcia niektorych relativne rezistentnych rastlin na narazove zvysenie koncentracie fluorovych exhalacnych splodin v okoli hlinikarne). Text in Slovakian. Biologia, 21(6):421-427, 1966. 19 refs.

Since 1961, annual studies have been conducted to determine the effect of fluorine emissions from an aluminum factory in the Hron valley, central Slovakia, on local vegetation. The checkered pattern of phytopathological symptoms observable on individual plants is the result of irregular diffusion and dispersion of pollutants, unequal intake of nutrients, and unequal physiological processes taking place in different parts of a plant. Different degrees of resistance to pollution encountered among plants of the same species are explained by plant location. In June 1964, large necrotic markings appeared on plant leaves, and the growth of plants relatively resistant to fluorine was inhibited. The spontaneous appearance of necrosis might have been provoked by a gradual accumulation of fluorine in the soil surrounding plant roots, finally reaching toxic levels, or by a sudden increase in fluorine concentrations emitted to both air and soil. The period of spontaneous necrosis was found to coincide with a period when, because of technical adjustments, factory emissions of fluorine were double the average of previous years. It is concluded that plants can serve as indicators of increased fluorine emissions resulting from modifications of electrolytic installations or breakdowns in operating procedures. (Author abstract modified)

14968

Daines, Robert H., Eileen Brennan, and Ida Leone

AIR POLLUTANTS AND PLANT RESPONSE. J. Forestry, 65(6):381-384, June 1967. 15 refs.

The effects of a number of acid gases and photochemically-produced pollutants on plants are described. A great variation in susceptibility to damage by such gases as fluorides and SO2

exist both among plant species and within a single species. Injury from these gases occurs primarily to younger leaves, with little or no damage shown by old leaves. Symptoms usually consist of marginal and tip necrosis with accompanying discoloration of the affected areas. Limited studies with chlorine suggest that it is less phytotoxic than hydrofluoric acid, requiring about 0.1 ppm to injure the more sensitive plants. Among the photochemically-produced pollutants, ozone has been known for many years to be toxic to a wide variety of plant species; ozone toxicity symptoms appear as flecks, stipple, streaks, spots, and tip necrosis. Injury appears on mature leaves, with the oldest leaves of young plants and middle-aged leaves of old plants being most susceptible. Peroxyacetylnitrate (PAN) and its analogues are highly phytotoxic, producing symptoms called 'silver leaf' and 'leaf banding' in California, the northeastern U. S., and other urbanized areas. Like ozone, these compounds are believed to cause severe annual economic losses in crop damage. Investigations of damage caused by other photochemical pollutants, namely ozonated hydrocarbons, bisulfite reaction products, and nitrogen dioxide, are briefly summarized, and the major sources of all the pollutants discussed are noted.

15213

MacLean, D. C., O. F. Roark, G. Folkerts, and R. E. Schneider

INFLUENCE OF MINERAL NUTRITION ON THE SENSITIVITY OF TOMATO PLANTS TO HYDROGEN FLUORIDE. Environ. Sci. Technol., 3(11): 1201-1204, Nov. 1969. 10 refs.

The influence of calcium, magnesium, and potassium on growth, fluoride accumulation, foliar injury, flowering, and fruiting of tomato plants exposed to gaseous hydrogen fluoride was tested. Tomato plants grown in sand culture and provided with a complete nutrient solution or solutions deficient in calcium, magnesium, or potassium were exposed to concentrations of hydrogen fluoride from 0 to 15.1 micrograms/cu m for periods of three, five, or 64 days. In magnesium-deficient plants, HF exposure resulted in a reduction in the dry weight of both tops and roots and an increase in the severity of magnesium deficiency symptoms on basal leaves. Foliar accumulation of fluoride was suppressed by magnesium deficiency. The effects of HF exposure on calcium- deficient plants were characterized by reduced top growth, increased foliar chlorosis, and an enhancement of necrosis on apical leaves. Fluoride accumulation was unaffected by calcium nutrition. The responses of potassium-deficient plants to HF were limited to increases in F accumulation and in necrosis on apical leaves. The differential responses of the elements to HF exposure were ascribed to differences in their mobility within plant tissues, the stability of fluoride salts formed, and/or their metabolic roles. (Author abstract modified)

15404

Yu, Ming-ho and Gene W. Miller

EFFECT OF FLUORIDE ON THE RESPIRATION OF LEAVES FROM HIGHER PLANTS. Plant Cell Physiol. (Tokyo), vol. 8:483-493, 1967. 28 refs.

The effect of fluoride on the respiration of leaves from Chenopodium murale and soybean (Glycine max, Merr., Hawkeye variety) was studied to establish whether respiration changes induced by fluoride could be correlated with ADP concentration by the use of 2,4-dinitrophenol (2,4-DNP) as an uncoupler. Fluoride treatment included both excised leaves cultured in nutrient solutions and leaves from plants fumigated with hydrofluorice acid atmosphere. Tissues treated with low fluoride concentrations which initially showed increased oxygen uptake eventually showed decreased oxygen consumption. Tissues treated with a high concentration of fluoride showed an increased oxygen uptake if analyzed soon after treatment initiation. Increase in respiration generally took place before visible damage was manifested. Decrease in respiration was correlated with pronounced injury of tissues. Besides concentration of fluoride and the time lapse of treatment, the pH of the culture solution in which fluoride was supplemented, tissue age, and plant species were important factors affecting respiration. For example, the fluoride effect was greater at pH 4.5 than at other values tested and stimulation of respiration by fluoride was greater at all pH values when inorganic phosphate was added. The effect of 2,4-DNP on respiration was very similar to that of fluoride in that the effect differed with pH, concentrations, time of treatment, leaf age, and plant species. The respiration of fluoride-treated leaves was stimulated less by 2,4-DNP than that of control leaves. (Author abstract modified)

15501

Treshow, Michael, Franklin K. Anderson, and Frances Harner

RESPONSES OF DOUGLAS-FIR TO ELEVATED ATMOSPHERIC FLUORIDES. Forest Sci., 13(2):114-120, 1967. 8 refs.

The response of Douglas fir trees to fluorides was studied near a phosphate reduction plant in Idaho, where about 200 acres of timber had been killed. Study trees, selected at increasing distances from the operation, were placed into groups according to the average fluoride content of the leaves. Radial growth, needle length, and dry weight of the trees in the various groups were compared before and during the operations. Radial growth of trees with a fluoride concentration under 50 ppm (the controls) was greatest when the phosphate plant was operating; at higher concentrations, radial growth was the least during operations, and significantly less than in the controls, even in the absence of leaf necrosis. Normal growth resumed following the closing of the phosphate plant. Needle growth followed an opposite pattern. Needle length was positively correlated with fluoride levels and negatively correlated with radial growth. Stimulation of needle elongation appeared to be the easiest response of needles to fluorides. Growth suppression was evident at higher concentrations. Needle burning and mortality developed when fluoride concentration of the leaves exceeded several hundred ppm. (Author abstract modified)

15604

Bovay, E. and A. Bolay

DISPERSION OF FLUORINATED GASES IN THE CENTRAL VALLEY. (La dispersion des gaz fluores cans le Valais central). Text in French. Agr. Romande. Ser. A, 4(5):33-36, 1965.

The movement of air masses in the Rhone Valley, based on topography, have a considerable effect on the location and the amount of fluoride pollution from the aluminum plants in the area. A map of the Rhone Valley indicates that the area of greatest pollution seems to be on the south side of the valley near the town of Martigny. Fluoride levels were determined in plants at verying distances from the source of pollution. In general, plants in the Martigny area seemed to have the highest fluorine content; the highest fluorine samples were from trunks of poplar trees in the Martigny area. High levels were also recorded in pear trees, potatoes, and apricots in the same area.

15838

Bovay, E.

FLUORIDE ACCUMULATION IN LEAVES DUE TO BORON-CONTAINING FERTILIZERS. Fluoride Quarterly, J. Intern. Soc. Fluoride Res., 2(4):222-228, Oct. 1969. 7 refs.

In Switzerland's Rhone Valley, apricot orchards and vineyards exposed to F(-) emissions from aluminum and phosphate fertilizer factories display typical fluoride-induced necroses of the foliage. Up to 600 ppm F(-) in dry matter is present in the plant tissue but, the damage is limited to a few strictly circumscribed, individually owned parcels of land. Field and pot-culture experiments showed that the high F(-) content in the plants resulted from boron-containing combined fertilizers obtained by direct reaction of sulphuric acid or nitric acid upon raw products. A particular chemical combination containing fluorine and boron is formed in the fertilizer during the manufacturing process. The action of this special combination is similar to that of potassium fluorborate. Experiments on beans conducted in a greenhouse with several fertilizers, including the special combined boron-containing fertilizer, proved that F(-) could be partially eliminated by washing the leaves with water. The boron content of the same tissues remained unchanged by washing, suggesting that F(-) penetrates plants through the roots.

16092

Halbwachs, Gottfried and Josef Kisser

DWARFISM IN FIRS AND BIRCHES CAUSED BY SMOKE IMMISSIONS. Centralblatt fuer das gesamte Forstwesen, 84(2-6):156-173, 1967. 34 refs. Translated from German. 29p.

A morphological and anatomical study of dwarfed varieties of Norway spruce and birch was made. Dwarfism was exclusively caused by the effect of fluorine containing emissions. This influence was exerted directly on the needles and leaves wherein the development was inhibited and the numbers were reduced as a consequence of chronic and acute damage. The metabolism was directly reduced as well as the assimilation performance of the cells that remained intact. The establishment of trees was only possible because of the protecting influence of the neighboring vegetation of lower plants. As soon as individual branches began to grow above this protecting layer, they reached the immediate zone of influence of emissions and died off. This process, repeated every year, prevents a height gain and leads to a dense, bushy growth. The shape of the dwarfed birch is caused by elongation of basal buds. The size of the needles and leaves was greatly reduced particularly on the weather side which was in direct contact with the fluorine emissions. The reduction was due to a decrease in number as well as the size of the cells. Both varieties had considerably more pitch rays which were considerably lower in height. The number of ray cells per unit area was increased as compared to normally developed spruce trees. With birth, this was not found; however, the ray cells were generally narrower and lower. Further study is needed to learn whether such changes in the number of ray cells per surface unit are specific only for coniferous trees or whether they represent a general characteristic of the wood structure of dwarfed tree forms due to different factors.

16150

Garber, K.

THE IMPORTANCE OF AIRBORNE SALT AEROSOLS TO PLANTS. (Ueber die Bedeutung der Salzaerosole in der Luft fuer die Pflanzen). Text in German. Zentr. Aerosol-Forsch. (Stuttgart), 12(1):24-33, June 1964. 29 refs.

Plant damage, observed after heavy storms on the coast of the North Sea, raised the question of possible injury by salt aerosols. The present knowledge of the effects of salts on plants is discussed. Numerous papers point out that sodium fluoride in 0.2% solution kills the leaves of trapa, elodea and vallisneria within 24 hours, and a 0.025% solution has an adverse effect on germination. NaCL solutions (0.5 to 1%) cause hardly any injury, while KCl in 0.25 to 0.5% solution injuries bean plants; KCL03 in 0.01 and 0.025% solution is toxi. Ammonia may harm plants in liquid as well as in gaseous states; NH4OH is harmful even in 0.01% solution. As has previously been pointed out, Cl, Na, Mg, Ca, K, NH3-N,B, etc. in weak concentrations serve as plant nutrients. The sensitivity of the various plants to salt solutions differs. Of the most common plants cultivated in Germany, summer barley is least sensitive; beans are highly sensitive; and leaves of plum trees are particularly sensitive. To test whether salt aerosols are as damaging as salt solutions, test plants were exposed for half an hour to the following salt aerosols in 5% solutions: Na2CO3, K2S04, NaN03, NaCl, NaF and sea salt. Of these, NaF, NaCl, and sea salt had an injurious effect. The leaves were burned on the rim and began to roll up. NaCl discolored the needles of the picea excelsa. A table lists in detail all injuries observed on the various plants tested (begonia semperflorens, valerianella, gomphreno, lupinus luteus, picea excelsa).

16152

Garber, Kurt

A STUDY OF THE INTAKE OF TOXICANTS THROUGH THE BARK OF TREES. (Ueber die Aufnahme von Schadstoffen durch die Rinde der Baeume). Text in German. Wiss. Z. Tech. Univ. Dresden, 11(3):549-552, 1962. 12 refs.

The retention of fluorine and its compounds in the bark of trees is discussed. Analysis of the barks of willows, poplars and alders stemming from the vicinity of a superphosphate plant showed considerable amounts of fluorine; hardly any traces were found in the wood. The quantitative analysis of fluorine by perchloric acid distillation showed that a relationship exists between the fluorine content in the bark and the distance of the emission source. Gassing experiments with hydrofluoric acid on three-year old barren trees and cut branches in the winter showed that the fluorine content rose to between 33 and 65 mg in 100 g dry substance, depending on the exposure time; 1.71 to 4.28 mg fluorine was found in the wood. In non-exposed trees, fluorine concentrations of 0.9 to 1.6 mg in the bark and 0.2 to 0.3 mg in the wood were found. A further series of gassing experiments with trees during the winter period showed that the fluorine content of the leaves was twice or three times as high as that of non-exposed trees. Maple leaves from trees whose bark was treated with a 2% sodium fluoride solution also showed an increased fluorine concentration. Trees in the vicinity of a tar and asphalt plant stored higher concentrations of tar containing substances in the bark and, to a less extent, in the wood. Barren trees in the winter were exposed to ammonia. NH3 could be found in the bark; it was not found in the wood.

16222

Guderian Robert, Hans Van Haut and Heinrich Stratmann

EXPERIMENTAL STUDIES OF PHYTOTOXIC HYDROGEN FLUORIDE CONCENTRATIONS. (Experimentelle Untersuchnungen ueber pflanzenschaedigende Fluorwasserstoff-Konzentrationen). Text in German. Forschungsber. Landes Nordrhein-Westfalen, no. 2017:54p., 1969. 48 refs.

The resistance of important plant cultures to hydrogen fluoride and the HF concentrations which cause plant injuries at long-

term exposure were determined. The test plants were exposed to certain HF concentrations in small plastic greenhouses. Studies of the resistance of certain agricultural and forest plants lead to the formation of various resistance groups which are important for diagnosis as well as for the selection of plants for cultivation in HF polluted areas. For diagnosing purposes, the resistance groups were established with respect to leaf resistance; the yield was used as a criteria for establishing resistance groups in the planning of plant cultures. Tuberous plants e.g., tulips, crocusses, narcissas, etc., are not suitable for cultivation in HF polluted areas. Peas, beans and lupines showed a higher yield reduction than oats, corn, and summer rap. HF pollution might lead to drastic changes, such as reduction of less resistant plants which in turn enhances the growth of resistant species. Concentrations of 1 to 2 microgram HF/cu m caused severe injuries in tuberous plants after several days of exposure. In grasses and various types of clovers, a fluorine accumulation of 9 mg/100 g dry substance was found at a 16 day exposure to an average concentration of as little as 0.85 microgram HF/cu m. Winter barley showed a yield reduction after 12 days of exposure to 3.3 microgram HF/cu m. Oats, lupines, and peas showed a growth retardation at concentrations above 4 microgram HF/cu m. Spruces, Weymouth pines, Japanese lark, and Nordmann hemlocks began to show needle injuries after several days of exposure to concentrations between 1.5 and 4 microgram HF/cu m. Older leaves generally showed higher fluorine accumulations than young ones.

16244

Thomas, Moyer D.

AIR POLLUTION WITH RELATION TO AGRONOMIC CROPS: I. GENERAL STATUS OF RESEARCH ON THE EFFECTS OF AIR POLLUTION ON PLANTS. Agron. J., vol. 50:545-550, 1958. 39 refs.

Plant damage caused by sulfur dioxide, fluorine compounds, and smog is summarized. Sulfur dioxide causes two types of leaf injury: acute and chronic. The acute markings are marginal or interveinal collapse areas; their color is usually ivory. The chronic markings are areas of limited cell injury but not total collapse; the colors range from yellow to brownish-red to white and represent fumigation treatments or prolonged exposure to low concentrations. No reduction in yields have been demonstrated in plants exposed to sulfur dioxide unless there was leaf injury. The fluoride pollution problem as two aspects: direct injury to commercial and ornamental plants and the risk of fluorosis in cattle and sheep exposed to contaminated vegetation. Hydrogen fluoride and silicon tetrafluoride are extremely toxic to a few plant species. Hydrogen fluoride in ppb concentrations cause lesions resembling those due to sulfur dioxide. Photosynthesis experiments, the results of which are presented in tables and graphs, indicate that each crop has its own threshold limit which varies from 5 ppb for gladiolus to about 500 ppb for cotton. Smog damage to vegation is of two kinds: that produced by London coal smoke or fog containing sulfur dioxide; and Los Angeles smog, which is a mixture of oxidants. California smog injury tends to appear as a band on a leaf. Owing to the presence of organic compounds, ozone damage is rarely found in the field. The question remains open whether leaf damage from London fog is due to sulfur dioxide or to other toxicants.

16245

Hill, A. C., I. G. Transtrum, M. R. Pack, and W. S. Winters

AIR POLLUTION WITH RELATION TO AGRONOMIC CROPS: VI AN INVESTIGATION OF THE 'HIDDEN INJURY' THEORY OF FLUROIDE DAMAGE TO PLANTS. Agron J., 50(9):562-565, 1958. 15 refs.

Moscow and Loren Blood tomato plants were injected with hydrogen fluoride for approximately four weeks, and the effect of fluoride exposure on the photosynthetic rate, respiration rate, and chlorophyll contents of the plants were determined. The fluoride concentrations used were higher than are likely to be encountered around fluoride-emitting factories. Extremely high fluoride levels accumulated in the foliage under high fluoride treatment, but only small amounts in the fruit and peeling. The fluoride treatment, even at the highest levels, did not affect photosynthetic rates. Growth and vigor of thy plants were excellent under all treatments while fruit size and set were good. Plant height was unaffected. The chlorophyll contents of the leaves and the respiration rate of the treated plants were not significantly higher than in control plants. The results strongly indicate that hidden injury to crops does not occur at the levels of gaseous fluoride present in the atmosphere around modern industries.

16385

Takeharu, Hideo

EFFECTS OF AIR POLLUTION ON PLANTS. Preprint, no source given, 4p., 1968 (?).

Current and recommended future research studies by Japanese investigators on the effects of air pollution on plants are reviewed. Local universities and agricultural research stations are emphasizing studies of the possible damage caused by sulfur dioxide, hydrogen fluoride, chlorine, and chromium from industrial sources to farm crops, tea, fruit, forest and mulberry trees, and young silkworms. Systematic basic research is being carried out by national research institutes on such problems as the symptoms and mechanism of injury to crops exposed to HF, and on atmospheric diffusion phenomena; a program is also in the planning stages to study nationally the effects of pollutants on the flowering and fruiting of plants near factories and power stations and in urban green belts. A number of subjects are proposed for high priority in future research planning: these include chronic damage to plants from long-term, low-concentration exposure to pollution as opposed to the more readily known acute symptoms; effects of such pollutants as ozone, nitrogen compounds, and ethylene; improvement of the methodology of field observations and gas chamber tests; the variables in the plants themselves that affect their susceptibility to damage; control methods, including fertilizer improvements, planting and cultivation methods, and shading; selection of smoke-resistant species of various plants; and a listing of indicator plants in urban environments.

16387

Hill, A. C. and M. R. Pack

OCCURRENCE OF FLUORIDE IN PLANTS AND ITS EFFECTS. Preprint, 72p., 1960 (?). 113 refs. (Published as a chapter in the book 'A Summary and Evaluation of the Problem of Air Pollution With Fluoride'. C. S. Brandt (ed.), U. S. Dept. of Agriculture.)

The available data on the relationship of atmospheric fluorides to plants is reviewed and evaluated. Fluoride occurs naturally in plants but is present in elevated levels in locations near certain industrial emitters. In contrast to the relatively low amounts of fluoride normally taken up from the soil, leaf concentrations of several hundred ppm have been reported for crops near fluoride emitters, entering the leaf primarily through the stomata. The rate of accumulation is apparently proportional to the atmospheric concentration of fluoride; the

amoung of fluoride in the plant is directly related to the exposure factor CT (concentration times time). The amount of fluoride deposited on or absorbed by the vegetation on a given area of lead during a given time period tends to be constant; therefore, the greater the amount of vegetation present, the lower its probable fluoride concentration. Accumulation varies with species; tomato, potato, raspberry, carrot, larch, and pepper leaves show high levels while pine, fir, corn, laurel, rose, and gladiolus tend to be low. Rain is effective in reducing the fluoride content of vegetation; other sources of loss are under study. Samples collected in connection with injury studies are generally limited to the leaves, the usual site of damage. Periodic sampling of the forage being consumed by livestock is essential. Sampling methodology, the distribution of fluoride within the plant, and variables affecting plant susceptibility are discussed. Atmospheric fluoride concentrations in emitting locales usually average from a few hundreths to 2 or 3 micrograms/cu m. The forms emitted include hydrogen fluoride, cryolite, calcium fluoride, and silicon tetrafluoride. It appears that gaseous fluorides are much more phytotoxic than particulate emissions. In general, the gross symptoms of fluoride injury consist of necrotic leaf lesions; other signs of damage are reviewed in some detail for various types of plants. The effects of fluorides on growth and yield, tissue destruction, photosynthesis rates, inhibition of enzymes, respiration, and chlorophyll are discussed, and suggestions for future research are made.

16399

Yamazoe, Fumio

SYMPTOMS AND MECHANISM OF INJURY TO CROPS EXPOSED TO HYDROGEN FLUORIDE. (Fukkasuiso myoru engai no jittai narabini kisaku nikansuru kenkyu). Text in Japanese. Nogyo Gijutsu Kenkyusho Hokoku, Dojo. Hiryo (Bull. Natl. Inst. Agr. Sci. Ser. B), no. 12:1-125, Feb. 1962. 111 refs.

The effect of hydrogen fluoride on the growth and yield of the main crops of Japan and the typical symptoms and mechanism of injury was studied, as well as a method for reducing injury. A fumigation chamber was built in which several crops were grown in Wagner's pots and exposed to hydrogen fluoride which was colorimetrically determined with aluminum hematoxylin. A significant decrease in yield was obtained with 25 ppm HF for paddy rice or barley and 50 ppm HF for wheat after fumigation for 1 hr. It was also found that the amounts of nitrogen, silicon, and fluorine was related to injury. Injury was more severe under high humidity and in daylight. Symptoms of fluorine toxicity in paddy rice were tip and marginal scorching of the younger expanded leaf, greyish green color of the terminal leaf, and wilting and yellowish brown color after two days. Chlorophyll in the parenchyma was decolorized, cytoplasm and cell membranes were decomposed, and the injured part was chlorotic. The amount of transpired water was reduced, carbon assimilation almost ceased, respiration was accelerated, pH was lower, and nitrogen assimilation was retarded. A recommended method of preventing plant injury was to avoid excessive application of nitrogen fertilizers, add substantial amounts of silica to the nitrogen supply, and spray a lime-suspension at the ear-forming, heading, or flowering stage. The comparison of susceptibility to HF was made with up-land and low-land rice, soybean, rape, garden radish, and Chinese rape. Rape was indifferent, and up-land rice was more sensitive than low-land rice. Soybean was very sensitive; garden radish and Chinese rape showed symptoms of injury at concentrations as low as 10 ppm HF. From the results of infrared absorption and solubility data, it was supposed that fluorine exists chiefly as a slightly water-soluble fluosilicate in the injured part of Gramineae and as a water-insoluble calcium fluoride in Leguminosae or Cruciferae.

16472

Brewer, R. F., F. H. Sutherland, and F. B. Guillemet

THE RELATIVE SUSCEPTIBILITY OF SOME POPULAR VARIETIES OF ROSES TO FLUORIDE AIR POLLUTION. Proc. Am. Soc. Hort. Sci., vol. 91:771- 776, Dec. 1967. 9 refs.

The relative sensitivity of various popular rose varieties to fluoride air pollution was studied. Fourteen varieties of hybrid roses were exposed to 2 ppb by weight F as HF for 6 months under controlled conditions in specially equipped greenhouse exposure chambers. All of the varieties used exhibited symptoms of F toxicity, but there was considerable variation in response among the varieties. Dry weights of tops were significantly reduced as a result of the F treatment in most varieties but this reduction in top weight was accompanied by an increase in total linear growth in 3 varieties. Foliar symptoms of F toxicity ranged from mild interveinal chlorosis to severe marginal necrosis. Of the varieties tested, 3 become chlorotic, 5 others exhibited slight to moderate marginal necrosis patterns and the remaining 6 developed both chlorosis and necrosis patterns as a result of exposure to HF gas. An apparent stimulation of shoot growth by exposure to HF resulted in more compact, dwarf-like plants with many weak branches. In some cases this resulted in more blooms per plant, but the flowers produced were of poor quality with short, weak, stems. Most of the F absorbed by the rose plant accumulated in the foliage. Stems and flowers contained one tenth to one twentieth as much F, respectively, as the leaves. (Author abstract modified)

16567

Martin, J. F. and F. Jacquard

INFLUENCE OF FACTORY SMOKE ON LICHEN DISTRIBUTION IN THE ROMANCHE VALLEY (ISERE). (Influence des fumees d'usines sur la distribution des lichens dans la vallee de la Romanche (Isere)). Text in French. Pollut. Atmos. (Paris), 10(38):95-99, April-June 1968. 15 refs.

Four manufacturing plants produce pollutants in the Romanche Valley, between Le Roure-d'Oisans and Vizille; one produces hydrogen fluoride and three produce particulate matter. The plant farthest down the valley produces calcium carbonate and gives off smoke, the solid matter of which consists of 50% calcium oxide and oxides of magnesium, silicon, iron, aluminum, and carbon. The second and fourth factories produce ferro-alloys and calcium carbonate and have similar pollutants. The third factory is an aluminum plant and produces fumes of hydrogen fluoride and other fluorides. Micrometeorological studies showed that the direction of the smoke was usually up-valley, with local and minor variations. The pH of the snow fall in the region of the factories averaged about 10, with values of 11.2 and 12.2 registered during February 1965 and December 1966. The pH of the rain averaged 10, and the pH of the bark of trees growing near the factories was also alkaline. Bark from similar trees near Grenoble had an acid pH. Rock surfaces in the area were covered with a gray-blue patina. Three zones of lichen growth were identified: poor growth of toxitolerant and coniophile lichens, up to approximately 500 meters from the factories; a transition zone; and a 'normal' zone, the boundaries of which varied within wide limits, but were approximately 1 km from the factory. Growth in the third zone corresponded to that in non-polluted areas. A list of lichen species identified is presented.

16617

Dost, Frank N., D. J. Reed, and C. H. Wang

INORGANIC FLUORIDE PROPELLANT OXIDIZERS. VOLUME II. EFFECTS UPON MICROORGANISMS, FISH, AND PLANTS. Oregon State Univ., Corvallis, Science Research Inst., Contract AF 33(615)-1767, Proj. 6302, Task 630204, AMRL-TR-187 (vol II), 59p., Nov. 1968. 7 refs. CFSTI, DDC: AD 684176

The effects of the inorganic fluoride oxidizing agents (chlorine trifluoride, chlorine pentafluoride, bromine pentafluoride, oxygen difluoride, nitrogen trifluoride, and tetrafluorohydrazine) upon selected species of microorganisms, fish, and plants were studied. Interhalogens were directly injected into water in a closed vessel to provide a reaction mixture. The biological activity of accidentally released chemical agents cannot be studied without considering their reactions with soil, the atmosphere, and the aqueous phase of the environment. Whether gaseous intoxicants can contact biological species resident in aquatic media or soil depends on the probabilities of dispersion of any given gas and for its affinity for and/or reactivity with the physical substrate. Each of the compounds studied is a candidate oxidizer for missile propulsion. In acute exposure of less than 1 hour, the interhalogens, as gases, were destructive to plants at atmospheric concentrations of 10-30 ppm; in aqueous solution, they were lethal to fish and microorganisms at concentrations of 10-25 micrograms fluoride per milliliter. The latter effects resulted from formation of inorganic acids and various oxidizing species, either of which is lethal alone and which can be neutralized by basic compounds and reducing agents and by filtration through soil. Oxygen difluoride was toxic to plants at concentrations in air as low as 1.5 ppm over a 30-min exposure period but had no effect upon aquatic species. Nitrogen trifluoride and tetrafluorohydrazine are nearly innocuous to nonmammalian organisms. (Author abstract modified)

16673

Stein, G.

REGIONAL DIAGNOSES OF SMOKE DAMAGE IN THE FORESTS OF KRUSNE HORY, CONDUCTED BETWEEN 1964 AND 1966, AND THEIR RESULTS. (Metoda velkoprostorove diagnosy kourovych skod v lesich Krusnych hor, uskutecnena v letech 1964-1966, a jeji vy-sledek). Scientific and Technical Society, Prague (Czechoslovakia), Agriculture and Forestry Section, Proc. Conf. Effect Ind. Emissions Forestry, Janske Lazne, Czechoslovakia, 1966, p. VII-1 to VII-16. 15 refs. Translated from Czech. Franklin Inst. Research Labs., Philadelphia, Pa., Science Info. Services, 17p., April 1969.

Investigations of smoke damage in the Annaberg, Marienberg, Freiberg, Tharandt, and Pirna National Forests of Czechoslovakia from 1964 to 1966 are described; spruce covered 85% of the area surveyed. Analysis of tree rings by borings showed a significant decrease in growth rates of spruce stands in the last 10 years. Spruce fascicles were shown to have the ability to store sulfur, but no relationship to the degree of tree damage was established. Analysis of the fluorine content in bark and of variations in acidity of the humus layer were also carried out, the degree of acidity does not appear to be correlated with the degree of injury. Trace elements found in the humus were in concentrations too small to be phytotoxic. A survey of existing and planned emission sources was made, including nearby areas of Germany, and a permanent network of 12 measurement stations for continuous atmospheric samplings of sulfur dioxide and dust was established along the border between Fichtelberg and Elbe; the stations will also make relevant meteorological observations.

16894

Poovaiah, B. W. and H. H. Wiebe

TYLOSIS FORMATION IN RESPONSE TO FLUORIDE FUMIGATION OF LEAVES. Phytopathology, 59(4):518-519, April 1969. 6 refs.

Atmospheric fluoride typically causes injury and necrosis at the tips and edges of leaves. In earlier anatomical studies, microscopically detectable changes were reported only for macroscopic injury. In this report, the occurrence of tyloses in the xylem at some distance from the principal site of fluoride injury is discussed.

16896

Brewer, R. F., F. H. Sutherland, and F. B. Guillemet

EFFECTS OF VARIOUS FLUORIDE SOURCES ON CITRUS GROWTH AND FRUIT PRODUCTION. Environ. Sci. Technol., 3(4):378-381, April 1969. 10 refs.

The effects of fluoride accumulation by citrus trees were studied using several techniques of exposing the trees to soluble fluorine compounds. Weekly sprayings with dilute (0.00125 to 0.0025N) NaF or HF solutions resulted in gradual fluoride accumulation in citrus foliage and produced toxicity symptoms which were indistinguishable from those observed on similar trees exposed to low concentrations of HF gas. Results of intermittent exposure of young citrus trees to HF gas were very similar to those associated with comparable fluoride accumulation from weekly sprayings with NaF or HF solutions. Reduction in top growth of citrus exposed to soluble fluorides was closely correlated with reduced photosynthetic area resulting from smaller leaves and increased leaf fall. Continuous exposure to HF gas resulted in more severe growth retardation than intermittent exposure to higher concentrations or periodic sprayings with soluble fluorides even though approximately equivalent amounts of F were absorbed in all three treatments. (Author's Abstract)

16900

Mohamed, Aly H.

CYTOGENETIC EFFECTS OF HYDROGEN FLUORIDE ON PLANTS. Fluoride Quart. Repts., 2(2):76-84, April 1969. 8 refs.

Studies on the effects of HF on meiotic chromosomes of tomatoes indicated a trend toward a higher frequency of chromosomal aberrations with an increase in the fumigation period. It was indicated that HF was capable of inducing paracentric inversions with the possibility of the induction of deficiencies, duplications, or even translocations. The progeny obtained from the treated plants produced a number of abnormal phenotypes, the same as, or similar to, known mutations. Further studies in maize microsporocytes for plants treated with HF confirmed the cytological results obtained in tomatoes with clear evidence of the occurrence of inversions, translocations and deficiencies. These results suggest that HF seems to affect primarily the DNA molecule by blocking its replication, probably through its action on the enzymatic systems. (Author's Summary)

17109

MacLean, David C., Delbert C. McCune, Leonard H. Weinstein, Richard H. Mandl, and George N. Woodruff

EFFECTS OF ACUTE HYDROGEN FLUORIDE AND NITROGEN DIOXIDE EXPOSURES ON CITRUS AND ORNAMENTAL PLANTS OF CENTRAL FLORIDA. Environ. Sci. Technol., 2(6):444-449, June 1968. 11 refs.

Six citrus varieties and six ornamental species of economic importance to central Florida were subjected to high concentration-short duration exposures of gaseous hydrogen fluoride or nitrogen dioxide. Postfumigation observations showed that the effects of acute pollutant exposures differed markedly from those of chronic exposures. Hydrogen fluoride exposures of 0.5 to 10 ppm for periods of from 0.5 to 8 hours induced tip, marginal, and intercostal chlorosis and necrosis, and abscission of leaves of most plants tested. Symptoms were most severe on, but not limited to, young leaves. The effect of duration of exposure had a greater influence on abscission of young citrus leaves than did HF concentration. However, the effect of HF concentration on foliar F accumulation could not be separated from exposure time. The NO2 concentrations used ranged from 25 to 250 ppm for periods of from 10 minutes to 8 hours. Nitrogen dioxide damage was characterized by rapid tissue collapse, necrosis, and defoliation. Symptoms were sporadic in appearance, affecting leaves of all ages. The relative contributions of concentration and duration to NO2 induced injury were about equal. (Author abstract modified)

17163

Spierings, F. H. F. G.

CHRONIC DISCOLORATION OF LEAF TIPS OF GLADIOLUS AND ITS RELATION TO THE HYDROGEN FLUORIDE CONTENT OF THE AIR AND THE FLUORINE CONTENT OF THE LEAVES. Neth. J. Plant Pathol., vol. 73:25-28, 1967. 5 refs.

The gladiolus variety Snow Princess, which is very susceptible to hydrogen fluoride, was used in field experiments to investigate the correlations between traces of HF occurring in the atmosphere, gradually developing leaf tip injury, and fluorine content of injured leaves. Seven experimental fields were laid out for investigation: one in an industrial area near the sea; one far from any industry but at the same distance from the sea; three on different soil types in Wageningen; and two in pollution free areas. At regular intervals, the plant injury was estimated by measuring the length of leaf tip injury. Fifteen cm lengths of injured leaf tips were cut and analyzed for their fluorine content. The average HF pollution in the atmosphere was estimated by using filter papers soaked in Ca(OH2). Fields where HF concentrations were low displayed very slight and very gradually developing leaf tip injury. In the four fields with measurable pollution, more serious injury occurred. The content of HF in the atmosphere also correlated with the fluorine content of the damaged leaf tips. It was concluded that leaf tip injury was caused by HF.

17449

Spierings, F.

INFLUENCE OF AIR POLLUTION ON CROP PLANTS IN SOME INDUSTRIAL AREAS IN THE NETHERLANDS. (Invloed van luchtverontreiniging op land- en tuinbouwgewassen in d' nabijheid van enkele industriecentra in Nederland). Text in Dutch. Inst. of Phytopathological Research, Wageningen (Netherlands), Rept. 217, 58p., 1957 (?). 8 refs.

Prompted by serious damage to plant bulbs caused by air pollution in an area northwest of Amsterdam, the Institute of Phytopathological Research conducted a study in that area and two other relatively large areas: west of Rotterdam and east of Sluiskil (Zeeland, near the Belgian border). A field investigation was first made, using specially controlled flower beds of gladiolus and alfalfa, which are particularly sensitive to hydrogen fluoride and sulfur dioxide, respectively, these two industrial gases being considered the most dangerous to plant growth. Distribution of the intensity of damage on the experimental plots indicated the direction taken by the noxious gases, their manner of propagation, and the extent of damage caused. Damaged leaves were then analyzed chemically for fluorine or sulfur content. Commercial crops were compared with those experimentally grown, and crops from areas known to be free of pollution were compared with those from the affected areas. Plants were also 'fumigated' at the Wageningen laboratory, under simulated practical conditions. Comparisons were made of varieties of the two kinds of plants that were known to be either sensitive or insensitive to the industrial gases. The freesia plant, which suffered extensive damage in Dutch greenhouses during autum 1956, was also tested in the gas chambers. Two varieties of tulips were tested: Blue Parrot, which is sensitive to gases, and Preludium, which is not. Other plants tested were barley, broad beans, kidney beans, corn, lettuce, buckwheat, sugar beets, tomatoes, loosestrife, and knotgrass.

17620

Harris, Lorin E., Milton A. Madsen, Delbert A. Greenwood, J. Legrande Shupe, and Robert J. Raleigh

EFFECT OF VARIOUS LEVELS AND SOURCES OF FLUORINE IN THE FATTENING RATION OF COLUMBIA, RAMBOUILLET, AND TARGHEE LAMBS. J. Agr. Food Chem., 6(5):365-368, May 1958. 17 refs.

Ninety weanling wether lambs consisting of equal numbers of Columbia, Rambouillet, and Targhee breeds were used to study the effects of fluorine. Throughout the 14 week trial, the lambs were fed to maintain designated fluorine levels based on hay comsumption. Two sources of fluorine were used: sodium fluoride added to normal hay; and hay containing a fluoride residue from the stacks of industrial plants. When the hay containing up to 160 ppm fluorine was mixed with varying amounts of grain, fluorine levels of 14, 18, 32, 58, and 112 ppm were achieved in the dry diet. Results showed that fluorine up to 112 ppm had no effect on feed consumption, weight gain, market grade, dressing percentage and pelt weights, carcass weight and grade, clinical and histological effects, wool weight, fiber and staple length, and fiber diameter. It was concluded that lambs can be fattened on hay containing at least 160 ppm fluorine when it is fed with 50% grain, provided the total dry matter consumed does not contain more than 112 ppm fluorine.

17684

Adams, Donald F.

RECOGNITION OF THE EFFECTS OF FLUORIDES ON VEGETATION. Air Pollution Control Assoc., 13(8):360-362, Aug. 1963. 25 refs. (Presented at the 29th Annual Pacific Northwest Pollution Control Association Meeting in cooperation with the Pacific Northwest International Section of APCA, Oct. 24-27, 1962. Salem, Ore.)

A review of the problem of recognizing the effects of fluorides on vegetation is largely confined to discussing the methodology for establishing the effects of fluorides and other air pollutants on plants, particularly on commercially grown plants, describing reported methods of protecting plants from airborne fluoride molecules, and of methods of removing fluorides from leaf tissue by washing. Basic to a discussion of air pollutants is the defining of 'effects'. The effects of greatest concern are injuries which damage the plant for its intended use. Injury embraces all plant responses resulting from the action of the air pollutant, including alterations in assimilation rate on plant constituents, leaf necrosis, leaf or fruit abscision, or reduced or altered growth. Damage, on the other hand includes only

those forms of injury which change significantly the value of the plant in relation to its intended use. In the specific situation of alleged vegetation injury from airborne chemicals, the following experimental steps, based on Koch's Postulates for scientific investigative procedure (originally developed for study of bacterial infection) must be undertaken: 1) chemical analysis of the air must show that the particular chemical agent is always associated with the particular diseased condition; 2) chemical analysis of the plant tissue must show that the particular chemical agent is always present in elevated concentrations; the same species and varieties of plant must be exposed under controlled conditions to the suspected agent in the same range of concentrations found in experimental step No. 1, in the sense that the exposed plants must develop the same symptoms as observed in the field; 4) chemical analysis of the air and the exposed tissue from step No. 3 must compare with the levels found in steps No. 1 and No. 2.

17697

Berry, Charles R. and George H. Hepting

INJURY TO EASTERN WHITE PINE BY UNIDENTIFIED ATMOSPHERIC CONSTITUENTS. Forest Sci., 10(1):2-13, 1964. 16 refs.

A general decline of Pinus strobus L. in the Cumberland Plateau of Tennessee was determined, by an aerial survey, to be in the Kingston-Oak Ridge-Rockwood-Harriman industrial area. This disease, called post-emergence chronic tipburn, was also found in other industrial areas, including some which contained coal-burning power plants. Root and stem isolations yielded no primary pathogens. Pruning and fertilizing sometimes brought about improved vigor, but did not affect occurrence of needle tipburn, a primary symptom. Diseased trees transplanted out of the affected area recovered, while trees transplanted within the affected area continued to decline. Trees differed greatly in their susceptibility to the disease. Scions from susceptible trees displayed symptoms year after year, even when grafted to resistant trees in the affected area. Scions from resistant trees continued to be disease-free year after year, even when grafted to diseased trees. The grafting experiment furnished evidence that a virus was not involved and indicated that the cause of the trouble was an atmospheric agent. Members of susceptible clonal lines potted with the same soil mixture were injured when placed in the affected area, while others remained disease-free outside. This use of susceptible clones as biological indicators gave further evidence that the disease causal agent is atmospheric and that the level of resistance is genetically controlled. Analyses of diseased foliage showed that injury could occur without causing a conspicuous elevation of either sulfur or fluorine in needle tissues. Sulfur dioxide and fluorine are still regarded as possibly involved. (Author abstract)

17705

Dean, Gerald L.

EFFECTS OF FLUORIDE ON THE VIRULENCE OF TOBACCO MOSAIC VIRUS IN VITRO. Utah Univ., Salt Lake City, Dept. of Botany, Thesis (MS), June 10, 1966, 34p. 41 refs.

The relationship between fluoride introduced into plant foliage and the activities of viruses was investigated. Each leaf was inoculated at the tip with one drop of tobacco mosaic virus. Inoculated leaves were cut in half along the middle vein with a scalpel. The half leaves were placed on the surface of 250 cc of 5% water agar that was poured into aluminum trays. Fluoride was introduced into the pinto bean leaves by mixing various concentrations of sodium fluoride into 250 cc of 5% water agar before pouring into the aluminum trays. Flouride concentrations were made to 0.0001, 0.0005, 0.001, 0.0025, 0.005, 0.01, 0.025, 0.05 M. Controls contained no additional fluoride. After 24 hours, frequent observations were made for lesion development. The trays of half leaves were removed from the environmental chamber after 48 to 72 hours. High concentrations of fluoride, 0.025 to 0.05 M, caused chlorosis of the leaves before the lesions appeared. The molarities of 0.0005, 0.001, 0.005, and 0.01 produced the optimal increase in the fluoride content of the supported leaves. The relationship between the molar concentrations of the supporting agar and the amount of fluoride in the test leaves were significant at the 1% level. As the fluoride levels in the leaves increased above 60-80 ppm, there was an increase in lesion numbers on tests compared with control leaves until fluoride levels reached 400-450 ppm. At this concentration, lesion numbers showed a decrease. Above 500 ppm fluoride, the lesion numbers decreased to a level significantly below those of the control. At levels above 600 ppm, there appeared to be a strong inhibition of lesion numbers.

17710

Thomas, Moyer D. and Russel H. Hendricks

EFFECT OF AIR POLLUTION ON PLANTS. In: Air Pollution Handbook. P. L. Magil, F. R. Holden, and C. Ackley (eds.), New York, McGraw Hill, 1956, Sect. 9, 44p. 129 refs.

The effects of sulfur dioxide, hydrogen fluoride, chlorine, hydrogen chloride, nitrogen oxides, ammonia, hydrogen sulfide, hydrogen cyanide, mercury, ethylene, and pesticides on plants are surveyed, with special attention to effects on alfalfa, barley, and wheat. Damage to crops in Los Angeles County has been estimated at $500,000 yearly. The toxicity of sulfurous acid is attributed more to its reducing properties than to its acidity. (It is 30 times as toxic as sulfuric acid.) Analysis of plants for total sulfur and sulfate sulfur is a possible method of diagnosing sulfur dioxide injury. The relative sensitivities to sulfur dioxide of 90 cultivated plants and 29 native plants are given (alfalfa sensitivity equals 1.0). Time-concentration and yield-leaf-destruction equations are discussed. Hydrogen fluoride is poisonous to gladiolus and iris, to various types of grain, to pines and other coniferous trees, and some fruit trees. Susceptibility varies widely, even among species of the same plant. Some varieties of gladiolus are highly susceptible; others are highly resistant. Coal smoke as a source of atmospheric fluoride should not be neglected. Fluoride content of certain types of coal can be high as 295 ppm. In areas near Pittsburgh, readings of as high as 269 ppm of fluoride have been registered in tree leaves, and 53 ppm in grass. The effect of smog on plants is discussed, including a tabulation of the sensitivity of 47 plants cultivated in southern California and of 52 plants native to the area. The chemical composition of smog is also analyzed.

17749

Middleton, J. T., L. O. Emik, and O. E. Taylor

AIR QUALITY CRITERIA AND STANDARDS FOR AGRICULTURE. J. Air Pollution Control Assoc., 15(10):476-480, Oct. 1965. 36 refs.

Many food, fiber, forage, and forest crops and a number of animals are adversely affected by a variety of air pollutants. The effects of ethylene, fluorides, ozone, peroxyacyl nitrates, and sulfur oxides are discussed. Their effects upon animals and plants can best be judged by criteria which describe the reaction of biologic materials to pollutant concentration and exposure time. Four criteria are recognized: interference with enzyme systems; change in cellular chemical constituents and physical structure; retardation of growth and reduction in

production from altered metabolism; and acute immediate tissue degeneration. Information on tissue degenerative effects due to these pollutants is the most common. There are some reports on growth and productivity reduction, but little data are available on cellular alterations and interference with enzymes which are essential to the ultimate definition and prediction of the significance of the effects of pollutants on growth and productivity of agriculture. Dosage data are available which indicate the degenerative effects of some specific pollutants on certain tissues of hosts. Political-social judgements are made because of the knowledge of the effects of these specific pollutants. This knowledge permits the establishment of standards which define air quality necessary for the protection of agriculture. The setting of standards for a single pollutant effects upon crops and animals effectively serves as a precedent and indicates the necessity of establishing air quality values for pollutant mixtures emitted into and produced within the air resource at different geographic locations as the polluted air moves throughout the typically multigovernment jurisdictions of the airsheds. (Author abstract modified)

17779

Darley, Ellis F.

USE OF PLANTS FOR AIR POLLUTION MONITORING. J. Air Pollution Control Assoc., vol. 10:198-199, June 1960. 22 refs. (Presented at the Air Pollution Control Association 52nd Annual Meeting, Los Angeles, Calif., June 22-26, 1959.)

Plants used to monitor air pollution, whether they occur naturally or are cultivated, must meet certain requirements: they must be susceptible and display symptoms characteristic of the pollutant in question; they should be growing in a suitable environment and have rather wide distribution; and plant injury from pollutants must be distinquishable from that caused by insects, frost, or heat. Where naturally suitable conditions do not prevail, susceptible species can be planted in approximate sites or grown under controlled conditions. The characteristic symptoms caused by oxidants, ozone, fluorides, sulfur dioxide, and ethylene are described. In a few cases, a plant may detect more than one toxicant simultaneously, although the symptoms cannot always be separated. Plants can monitor concentration levels of pollutants as well as kind of pollutant. Plant monitoring is particularly useful where costs are a significant factor or in areas where air pollution is not suspected and chemical monitoring is therefore not normally in effect. The occurrence and spread of oxidant plant damage in California is described as an example of the use of plants for pollution monitoring purposes.

17822

Garber, K.

THE INFLUENCE OF FLUORINE CONTAINING EMISSIONS ON PLANTS. (Die Beeinflussung der Pflanzenwelt durch fluorhaltige Immissionen). Text in German. Angew. Botan., vol. 40:12-21, 1966. 18 refs. (Presented at the Botanikertagung, Bonn, Sept. 10, 1965.)

Typical symptoms of plant damage by fluorides are mottling of the leaves, bleaching of the leaf margin and tips, and necrosis and rolling of the leaves. The symptoms alone are sometimes not enough to make a correct diagnosis. It is necessary to determine the F-content of the plant. Several methods are available, such as distillation of the ashed substances with perchloric acid or sulfuric acid and subsequent determination of the F-content of the distillate by colorimetry or titrimetry. The natural F-content of plants must be known. It usually lies between 0.05 and 2.5 mg per 100 g dry substance. A table listing the natural F-concentrations of various types of plants is given. Tree barks can be used for the analyses if leaf samples are not available. A clear difference exists of F-concentration between the bark facing the F-source and the bark facing the opposite direction. To diagnose injuries, plants can be exposed in the pots in the polluted area under equal conditions. In one instance, the injuries were traced to sulfur dioxide rather than F-containing emissions. This shows that a higher F-content in the plant than is natural does not always mean that the visible injuries are a consequence of the higher F-content. Soluble NaF or KF dust on plants may reduce the chlorophyll content of plants. The sensitivity of the plants to fluorides varies and is influenced by the site, nutrition, and the climate.

17892

Bolay, A. and E. Bovay

OBSERVATION OF DAMAGE CAUSED BY FLUORINE COMPOUNDS IN VALAIS. (Observations sur les degats provoques par les composes fluores an Valais). Text in French. Agr. Romande, 4(6):43-46, 1965. 1 ref.

Observations made over a period of several years in the neighborhood of the Martigny and Chippis aluminum plants are reported. To determine whether plant damage has been caused by fluorine compounds, the conditions of three tests must be met: 1) accurate determination of the pathological symptoms in the plant; 2) chemical determination of fluorine; and 3) study of the typical symptoms of blight in related indicator plants. The intensity of damage due to fluorine blight is influenced by various factors: 1) atmospheric humidity and amount of precipitation; 2) sensitivity of a particular plant species; and 3) age of the plant. Damage to the leaves, flowers, buds, branches, and fruit of the apricot tree is discussed in detail. The tree is also subject to a type of chronic intoxication from fluorine that eventually leads to the death of the tree, but which is not always accompanied by visible symptoms. Also discussed are the effects on peaches, prunes, cherries, pears, apples, grapes, and strawberries. A list of 25 indicator plants is given.

17970

McNulty, I. B. and James L. Lords

POSSIBLE EXPLANATION OF FLUORIDE-INDUCED RESPIRATION IN CHLORELLA PYRENOIDOSA. Science, vol. 132:1553-1554, Nov. 25, 1960. 9 refs.

Increased oxygen uptake by Chlorella pyrenoidosa in the presence of sodium fluoride at various pH values was studied. NaF concentrations up to 0.000105M resulted in increased respiration as high as 60% above normal; above this concentration, oxygen consumption sharply dropped to below normal. A significant increase in phosphorylated nucleotides was found, suggesting that undissociated HF in the culture medium disrupts the basic energetic of the cell, thereby causing the increased oxygen uptake.

18226

INVESTIGATION AND APPRAISAL OF FLU-GAS DAMAGE. (Untersuchung und Begutachtung von Rauchschaden. Part I.), Translated from German. Hamburg Staatsinstitut fur Angewandte Botanik Jahresbericht, 5(119-120), 1938. 3 refs.

Plants exposed to flue gas showed definite damage from fluorine (F) and acids of sulfur and nitrogen. A crystalization method utilizing the microscopic identification of silico-sodium fluoride proved best for qualitative fluorine analysis of the 102 samples examined through 1936. As in previous studies, the

samples tested showed that F was taken in through the branch bark and leaves of cherries and pears. For the first time, however, the fruit itself was damaged and F detected there. Black, hard disks had formed around the flower and in the fruit adjacent to the flower. Samples examined long after damage took place showed no F present. Twenty-one samples were examined for acid damage. Large concentrations of nitrates were detected in the specimens by means of the diphenylamine-sulfuric acid reaction. Different plant species showed markedly different sensitivities to flue gases.

18265

Garber, K., R. Guderian, and H. Stratmann

INVESTIGATIONS OF THE FLUORINE INTAKE BY PLANTS FROM THE SOIL. (Untersuchungen ueber die Aufnahme von Fluor aus dem Boden durch Pflanzen.) Translated from German. Franklin Inst. Research Labs., Philadelphia, Pa., Science Info. Services, Contract No. CPA 22-69-30, Project No. C 2439, 20p., 1968. 9 refs.

This paper deals with the fluorine intake from the soil, and in particular, answers to the following questions are sought: 1. How great is the fluorine concentration of various types of plants grown in different soils? 2. What effect has a portioned fluorine addition to the soil on the F-concentration of the plant? 3. Are there fluctuations in the fluorine concentration of the plant during its vegetation period? 4. Are there any connections between the F-concentrations of various plant organisms? All investigations were performed in vitro and are based on the experiments on sulfur dioxide effects described by von Guderian (1960). The sites of the investigations are Hamburg, Biersdorf (Sieg) and Kettwig. With the majority of the experiments, the experiments, the computed fluorine concentrations were mixed with the soil prior to sowing. To determine the F-concentration in the experimental soils as well as in the sample plants the method by Oelschlager (1960) was used. The same types of plants show different F-concentrations which moreover do not correlate with the fluorine concentrations of the soils. The fluorine concentration of plants thus is not solely a function of the absolute fluorine concentration of the soil.

18266

Garber, K.

THE FLUORINE CONCENTRATION OF PLANTS. (Ueber den Fluorgehalt von Pflanzen.) Translated from German. Franklin Inst. Research Labs., Philadelphia, Pa., Science Info. Services, Contract No. CPA 22-69-30, Project No. C 2439, 10p., 1968. 10 refs.

Data are presented which indicate (1) that the fluorine intake by plants is independent of the fluorine concentration of the soil, and (2) that the natural fluorine content of plants lies between 0.2 and 2.0 (maximum 3.0) mg per 100g dry substance. Any higher concentrations can be traced to F containing immissions.

18267

Rohmeder, E., and A. von Schoenborn

INVESTIGATIONS OF PHENOTYPICALLY RELATIVELY FLUORINE-RESISTENT FOREST TREES. (Untersuchungen an phaenotypisch relativ fluorresistenten Waldbaeumen.) Translated from German. Franklin Inst. Research Labs., Philadelphia, Pa., Science Info. Services, Contract No. CPA 22-69-30, Project No. C 2439, 21p., 1968. 10 refs.

A total of 36 spruce trees, which had shown resistance to fluorine-containing pollutants for as long as 40 years, have been investigated for five years to determine (1) whether this resistance was due to genetic factors, better nourishment, more favorable water supply, etc., (2) what gas concentrations can be withstood by forest trees, and (3) if the selected spruces can withstand higher concentrations than other spruces of the same age and some deciduous trees which are known to be more resistant. The results indicate that (1) genetics is a very important factor and (2) forest damage from industrial pollutants can be reduced or eliminated if foresters would cultivate pollution resistant trees in industrial areas.

18268

Rosenberger, G., and H.-D. Gruender

INVESTIGATIONS INTO THE EFFECTS OF FLUORINE IMMISSIONS ON CATTLE IN THE NEIGHBORHOOD OF A HYDROFLUORIC ACID PLANT. (Untersuchungen ueber Fluorimmissionwirkungen bei Rindern im Bereich einer Flussaeure-Fabrik.) Translated from German. Franklin Inst. Research Labs., Philadelphia, Pa., Science Info. Services, Contract No. CPA 22-69-30, Project No. C 2439, 29p., 1968. 10 refs.

During the period of 3.5 years, twelve cows were kept under controlled conditions on a farm located in the emission area of a hydrofluoric acid plant. At the beginning of the test program the age of the cattle ranged from 3/4 to 9 years. The investigations covered the computation of the fluorine intake through the forage, the water and the air as well as the excretion by urine and incorporation in the bones. The state of health and the productivity of the cattle was constantly observed. The fluorine content of the farm-produced forage varied largely depending on the situation of the forage land with respect to the industrial plant. The monthly average of fluorine intake of the cattle varied between 1.0 and 9.5 mg F per kg body weight. All cattle showed symptoms typical for chronic fluorine poisoning, i.e. changes in teeth and bones as well as disturbances in locomotion. No influence of the fluorine intake could be detected on the fertility or on the milk productivity if this was less than 20 liters per day. Calves of cows with chronic fluorosis were not injured but do have an increased fluorine content of their bones.

18269

Trautwein, K., and Ch. Kopp

EFFECTS OF FLUORINE ON CATTLE UNDER EXPERIMENTAL AND PRACTICAL CONDITIONS. (Fluor-Wirkungen beim Rind unter experimentellen und praktischen Bedingungen.) Translated from German. Franklin Inst. Research Labs., Philadelphia, Pa., Science Info. Services, Contract No. CPA 22-69-30, Project No. C 2439, 31p., 1968. 16 refs.

In the period from 1961 to 1967 fluorosis was experimentally induced in test cattle by feeding them primarily with locally grown, fluorine-containing forage to which sodium fluoride or cryolite had been added. The total fluorine intake by the NaF-fed cows was 1.94 mg F/kg body weight per day, and by cryolite-fed cows 2.48 mg F/kg body weight per day. The fluorine intake thus exceeded the threshold value of about 1.75 mg F/kg body weight per day given in the pertinent literature. Fluorine elimination with the feces was found to be about 0.5 g of F per animal per day with NaF-fed cows and 0.9 g of F per animal per day with cryolite-fed cows. Along with the urine, 0.45 mg of F per animal per day were discharged by NaF-fed cows and 0.3 mg of F per animal per day by cryolite-fed cows. The analysis of tail vertebrae biopsies yielded a fluorine retention of 245 to 890 mg F/100 g ash over the period from 1960 to 1966 for the NaF-fed cows, and of up to 655 mg F/100 g ash for the cryolite-fed cows. The clinical symptoms

of fluorosis were slight to moderate yellowish, brownish spots as well as hypoplasia of the incisors, furthermore, weak and temporary functional disturbances of the motility were observed with some cows. The severity of these clinical symptoms were found to be dependent on the degree of fluorine emission. The general physical condition as well as the productivity of the test cows were in most cases satisfactory to excellent. Observations concerning spontaneous fluorosis in the Rheinfelden (Baden) emission area during the past 15 years show that the number and the severity of the disease in six communities had reached a peak in 1958 from whereon a steady decrease of the number of cases is found. This downward trend was parallelled by a decrease of the average fluorine content in the locally grown forage below the tolerance limit.

18270

Woehlbier, W., W. Oelschlaeger, G. Gronbach, and H. Giessler

THE RESORPTION OF FLUORINE BY OXEN FROM SOIL AND FLY DUST OF AN ALUMINUM PLANT. (Die Resorption von Fluor durch Ochsen aus Erde und Flugstaub einer Alluminiumhuette.) Translated from German. Franklin Inst. Research Labs., Philadelphia, Pa., Science Info. Services, Contract No. CPA 22-69-30, Project No. C 2439, 15p., 1968. 8 refs.

The resorption and retention of fluorine contained in three different substances such as NaF, fly dust from an aluminum plant and soil intermingled with fly dust which probably underwent a secondary fluorine reaction. All substances contained a fluorine compound with a relatively high water solubility. The fluorine retention was relatively high with soil, the fluorine excretion in the urine low. The supplementary feeding of the three fluorine-containing substances extending over 316 days brought various high levels of fluorine depositions which agreed with the quantities resorbed.

18271

Cohrs, P., H. Knosel, and Kl. Witte

INVESTIGATIONS ABOUT THE INITIAL STAGES OF THE MORPHOLOGICAL CHANGES OF ORGANS AND TISSUES IN DOMESTIC ANIMALS WITH FLUORINE POISONING. (Untersuchungen ueber die Anfangesstadien der morphologischen Organ- und Gewebsveraenderungen bei Fluorvergiftung der Haustiere.) Translated from German. Franklin Inst. Research Labs., Philadelphia, Pa., Science Info. Services, Contract No. CPA 22-69-30, Project No. C 2439, 10p., 1968. 11 refs.

Experiments are described in which sheep, pregnant sows, and weaned piglets were given fluorine orally in the form of an aqueous solution of sodium fluoride. Histological investigations were made and all organs, especially the endocrine glands, were investigated using usual methods and procedures. The fetuses of pigs and the suckling piglets showed no pathological changes in their developing teeth, in their bones and endocrine glands. Weaned piglets showed varied changes in teeth and bones according to the dose and duration of the application of NaF. Considerable weight reductions were observed in the thymus and adrenal glands of the test animals. No changes were observed in the pregnant sows. Sheep and lambs showed the same changes in teeth and bone tissue as were observed in the weaned piglets.

18272

Trautwein, K., R. Buchner, and Ch. Kopp

LABORATORY AND FIELD INVESTIGATIONS OF FLUORINE EFFECTS OF BEES. (Laboratoriums-und Felduntersuchungen ueber Fluor-Wirkungen bei Bienen.) Translated from German. Franklin Inst. Research Labs., Philadelphia, Pa., Science Info. Services, Contract No. CPA 22-69-30, Project No. C 2439, 10p., 1968. 22 refs.

According to experiments, no damages occurred to bees through dust and powdery substances containing fluorine. The following toxicity of dissolved fluorine compounds was found: a) Sodium fluoride; lethal dose equals 20 micrograms F per bee per 24 hours; 50% lethal dose equals 11 micrograms F per bee per 24 hours. b) Hydrofluoric acid lethal dose equals 10 micrograms F per bee per 24 hours; 50% lethal dose equals 5 micrograms F per bee per 24 hours. There are different sensitivities between the strains of bees and there is a repellent effect of hydrofluoric acid depending on its concentration. In 57 samples of 100 normal bees each, average values between 0.63 to 4.81 micrograms F per bee were found. The bees came from various regions with and without fluorine emissions. In the Rheinfelden emission area, only normal values of 0.6 to 2.8 micrograms F per bee were found in bees which were said to have died from fluorine emissions. Test colonies at a distance of 300 m from the plant showed no disorders after three years. In the Seelze emission region limiting values from 0.9 to 10.6 micrograms F per bee were found in bees which were said to be injured by fluorine emissions. Of two test colonies placed at a distance of 300 m from the plant, one died, the other developed badly during the three years of observation. In the examination of bees which are suspect of fluorine intoxication, other important diseases and aggravating factors must be recognized by differential diagnosis.

18319

Leithe, W.

RECENT RESULTS AND PROBLEMS CONCERNING THE ANALYSIS AND DAMAGES OF AIR POLLUTION. (Neue Ergebnisse und Probleme zur Analytik und Schadwirkung von Luftverunreinigungen.) Text in German. Allgem. Prakt. Chem. (Vienna), 20(2):36-37, Feb. 1969. 11 refs.

Nitrogen oxide has recently become increasingly important to air pollution not only because it is contained in automobile exhaust gases (up to 0.4% by volume) but because also it occurs in cigarette smoke (up to 0.1% by volume). Its toxicity, however, is only one-fifth of that of NO2. Its presence is determined by means of azo dyes after conversion into NO2. The injury threshold of NO2 for plants has recently been set at 0.4 ppm by H. van Haut and H. Stratmann, formerly, Czech and Nothdurft had placed the threshold at 30 ppm; their exposure time, however, was much shorter. Addition of NO to NO2 does not increase the toxicity. Present work has shown that even under unfavorable meteorological conditions no plant injuries were observed at an exposure of 0.4 ppm of NO2. A new analytical method for determining small concentrations of ammonia was developed. No description of the new method is given. It is remarkable that impingers retain less fluorine than fritted scrubbers. The SO2 injury threshold is still highly controversial. Some authorities believe that the SO2 emissions may be a useful function in plant nourishment. Sulfur dioxide exists for only about four days in the atmosphere. It is then washed out and penetrates the soil as sulfuric acid where it supplies the plants with the required sulfur. However, some experts view it only as a toxicant. Possible toxicity is a function of concentration.

18507

Knabe, Wilhelm

METHODS FOR SELECTION AND CULTIVATION OF EMISSION - RESISTANT WOODS. (Methoden der Auslese und Zuechtung Immissionsresistenter Gehoelze). Text in German. Preprint, International Union of Forest Research Organizations, Vienna (Austria), p. 2-21, 1967. 27 refs. (Presented at the International Union of Forest Research Organizations, Congress, Munich, West Germany, 1967.)

The need to select and raise woods resistant to air pollution in order to provide forests around urban areas is discussed. Sulfur dioxide, hydrogen fluoride, and ozone are probably the most noxious pollutants to coniferous species. Whether resistance to one of these phytotoxicants is independent or whether it enhances resistance to a whole range of pollutants should be investigated, as well as the mechanism of inheritance of resistance. Climate and soil conditions must be considered in planning selection experiments. Procedures applied to date to coniferous cultures throughout the industrial areas of Germany are reviewed.

18704

Johnson, Folke, D. F. Allmendinger, V. L. Miller, and C. J. Gould

LEAF SCORCH OF GLADIOLUS CAUSED BY ATMOSPHERIC FLUORIC EFFLUENTS. Phytopathology, 40(3):239-246, March 1950. 3 refs.

A hitherto undescribed disease, leaf scorch of gladiolus, was observed in areas polluted with fluorine compounds emitted from alumina reduction factories. The plant symptoms were reproduced by fumigation with hydrogen fluoride and were examined. Of the 72 varieties studied for their reactions to fluorine emissions and the amount of foliage injury or injury index, 7 were resistant (index less than 10), 13 were very susceptible (index 30-60), and the balance was between the two extremes. In general, the resistant varieties contained more fluorine in the foliage than the susceptible ones. The fluorine content of scorched plants from polluted areas was higher than that from unscorched plants in remote areas. (Author summary modified)

18770

Ivie, J. O. and C. R. Thompson

AUTOMATED VARIABLE LEVEL DISPENSING EQUIPMENT FOR HYDROGEN FLUORIDE. 9p., 1962 (?). 1 ref.

In a large field study of the effects of air pollutants on citrus, it was desired that hydrogen fluoride be added to the incoming atmosphere of greenhouses installed over individual trees. By substituting a series of valves with increasing sized orifices in place of the fixed bleeder valve, the fluoride dispensing system was modified to supply varying levels of the pollutant to the greenhouses so that the trees inside would be subjected to the same fluctuating levels of fluoride on an hourly basis as those in the ambient air outside. The automatic fluoride dispensing equipment is described.

19124

Compton, O. C., L. F. Remmert, J. A. Rudinsky, L. L. McDowell, F. E. Ellertson, W. M. Mellenthin, and P. O. Ritcher

NEEDLE SCORCH AND CONDITION OF PONDEROSA PINE TREES IN THE DALLES AREA. Preprint, Oregon Agricultural Experiment Station, Corvallis, Miscellaneous Paper 120, 6p., 1961. 8 refs.

A survey was designed to determine the nature of the injury to pine trees growing in and around the Dalles area in Oregon. Considerable injury from 'blight', or needle scorch, was found. Scorched needles contained considerably more fluorine than unscorched needles and were typical of 'ponderosa pine blight.' In the Dalles area, the percentage of scorch in 1960 needles varied from 0.9% at Station 12, which was 4 miles south of an aluminum factory, to 67.7% at Station 4, which was 1.2 miles WNW of the factory. The fluorine contents were 23% and 98%, respectively. The greatest amount of scorch was associated with higher fluorine content. No scorch was found in samples outside the Dalles area, and these samples were low in fluorine content. There was no pathological, entomological, or soil conditions that would account for the needle scorch found in the area. (Author conclusions modified)

19147

Hopp, H. H.

FLUORINE INJURIES TO VINE. (Fluor-bedingte Immissionsschaeden an Reben). Text in German. Die Wein-Wiss., 21(4):141-149, April 1966. 8 refs.

the vicinity of a lime kiln, injuries were observed on the leaves of the plants in the nearby vineyard in the extremely wet and cool summer of 1965. The leaves were necrotic, and the grapes had an extremely low sugar content. Measurement of the fluorine content in the medium to heavily injured leaves revealed concentrations which were 10 times higher than that of control plants. Fluorine concentration was only 8 times as high in the dead leaves as that in the control leaves, that the wash-out effect obviously becomes more apparent in entirely dead material. Since several rainy days had passed between the appearance of the symptoms and sampling, it is assumed that originally the fluorine concentrations in all samples must have been even higher.

19211

Yamazoe, Fumio

EFFECTS OF HYDROGEN FLUORIDE ON PLANTS. (Fukkasuiso no shokubutsu nioyobosu eikyo nitsuite). Text in Japanese. Kogai to Taisaku (J. Pollution Control), 6(7):515-520, July 15, 1970. 8 refs.

Symptoms of fluorosis in plants are chlorotic markings around the tip or edges of young leaves. Examples of damage to plants and livestock by fluorides are listed, including the retarded growth of silkworms fed on mulberry leaves polluted by more than 30 ppm fluorides. Plants can be classified into six groups according to their resistance to hydrogen fluoride. Theshold values of the fluoride concentration range from 5-10 ppb for the plants. Gladiolus is normally employed as a plant indicator for hydrogen fluoride and silkworms as indicator insects. The relationship between plant damage by fluorides and exposure time, density, soil, fertilizer, meteorology and location are examined. The mechanism of the damage is also analyzed. In a cicolous plant, Si-F bond, which is rather difficult to dissolve in water, is formed. In a calcicolous plant, on the other hand, a Ca-F bond, which is difficult to dissolve, is formed. In evaluating plant damage, 100 g of leaves are collected from several locations in an area. After rinsing by water, the sample is dried for 30 min at 90-100 C, and subsequently at 60-70 C for several hours. The sample is powdered, screened by 1 mm screen, and subjected to chemical analysis. Several preventive measures are listed, including the spraying of water or lime on plant leaves. It is concluded that the establishment of an environmental standard is difficult because of the extremely high sensitivity of the plants to the gas.

19358

Compton, O. C., L. F. Remmert, and W. M. Mellenthin

COMPARISON OF FLUORINE LEVELS IN CROPS BEFORE AND AFTER ALUMINUM FACTORY OPERATIONS IN THE DALLES AREA. Oregon Agricultural Experiment Station, Corvallis, Miscellaneous Paper 95, 27p., 1960. 7 refs.

The fluorine content of seven crops in the Dalles fruit area in Oregon were studied, beginning in August, 1953. Determinations of leaf fluorine were made four times previous to and three times since July 26, 1958, when a local aluminum reduction factory began operations. Leaf samples taken before July 1958 averaged less than 12 ppm fluorine. Similar samples taken after the start of operations at the factory ranged from 16 to 197 ppm, averaging 68 ppm fluorine. The June 1959 samples ranged from 6 to 106 ppm, averaging 26 ppm fluorine; those collected in August ranged from 18 to 207 ppm, averaging 73 ppm fluorine. The fluorine samples taken in October 1958 decreased from an average 140 ppm, 1 mile from the factory to 54 ppm, 4-5 miles away. Fluorine burn on leaves was severe in 1959 on certain apricot and prune trees growing within 2 miles of the factory. Peaches collected in 1959 showed a premature ripening and softening along the suture, the swelling often extending to the apex. This condition has not been observed previously in this area. (Author summary modified)

19539

Oelschlaeger, Walter and Erwin Moser

THE EXTENT OF PLANT DAMAGE CAUSED BY GASEOUS FLUORINE AS A FUNCTION OF ENVIRONMENTAL FACTORS AS WELL AS BY PULVERULENT FLUORINE AND FERTILIZER. Staub (English translation from German of: Staub, Reinhaltung Luft), 29(9):38-40, 1969. 9 refs.

Gaseous fluorine is the form of hydrogen fluoride and silicon tetrafluoride is the primary cause of plant damage caused by fluorine emissions. The toxic effect is governed by a number of factors including the fluorine content of air, the duration of absorption, the nature and age of the vegetation, rainfall and nutrient absorption, and fertilizers. Water conditions and nutrient supply constitute an essential factor for the necrosis caused by fluorine; at optimum nutrient supply, the resistance of forest trees to fluorine is higher. Increased light intensity and the associated high assimilation enhances the damaging effects. Soil with a high proportion of fluorine was used to grow various trees, and fly ash from an enamel shop was applied to the leaves. Solid fluorine particles were found to be less damaging than gaseous fluorine. Outside fluorine emission zones, plants can absorb large amounts of fluorine and be damaged by PK and NPK fertilizers containing boron in the BF4(-) complex.

19604

Webster, C. C.

THE EFFECTS OF AIR POLLUTION ON PLANTS AND SOIL. London, Agricultural Reseach Council, 1967, 53p. 198 refs.

Recent trends in the emissions and concentrations of smoke, deposited matter, and sulfur dioxide in Britain and the effects of these pollutants on plants and soil are presented. Factors affecting the action of sulfur dioxide on plants are susceptibility of different species and varieties, stage of growth, time of day, environmental conditions, concentration of gas and time of exposure, intermittent exposure, and fluctuating concentration of gas. The effects on plants and soil of fluorides and photochemical or oxidant smog are considered. The contamination of plants near highways with lead from the exhaust fumes of motor vehicles is included. Plants as indicators of pollution are also discussed.

19656

Weinstein, Leonard H. and Delbert C. McCune

IMPLICATIONS OF AIR POLLUTION FOR PLANT LIFE. Proc. Am. Phil. Soc. 114(1):18-21, Feb. 1970. 17 refs. (Presented at the Symposium on Atmospheric Pollution: Its Long-Term Implications, April 25, 1969.

The effects of an air pollutant on a plant may vary with respect to their manifestation and the circumstances of their occurrence. The best known are the visible lesions that appear on the foliage taking the form of chlorotic or necrotic areas distributed on the leaf in patterns characteristic of the plant and the pollutant. In affected broad-leaved plants, fluoride symptoms appear as marginal areas of chlorosis or necrosis. Sulfur dioxide effects are irregular necrotic areas between the veins. The symptoms of ozone injury may be flecks or patches of dead tissue on the upper surface. Peroxyacetyl nitrate attacks the underside of the leaf, giving it a glazed appearance. In the narrow-leaved plants, the foliar symptoms of pollutant injury are banding of the tips of the leaves. There are other changes that are not immediately apparent in occurrence or significance, such as effects on growth, yield, crop quality, physiology, and metabolism. Two basic approaches may be taken for control of pollutants that damage plants. The access of the pollutant to the plant may be restricted, or the pollution source may be removed from the receptor. It is also suggested that plants be developed that will be more resistan , or that practices be developed that will modify the response of plants to air pollutants. A brief history of the damaging effects of pollution on plants is presented.

19657

Pack, M. R.

EFFECTS OF HYDROGEN FLUORIDE ON PRODUCTION AND FOOD RESERVE CONTENT OF BEAN SEED. Preprint, Washington State Univ., Pullman, Air Pollution Research Section, 7p., 1969. 16 refs.

Mature seeds of Tendergreen bean plants, grown under continuous exposure to hydrogen fluoride at 10.5 micrograms F/cu m, had a shrivelled appearance and lower starch content than seeds of contro plants. Two more experiments were conducted in which bean plants were exposed continuously to HF at 2.1 and 9.1 micrograms F/cu m. These seeds also matured more slowly in the HF treatment and tended to be shrivelled and distorted. They had a faded blue-black color rather than the glossy black of the control plants. These differences were most pronounced in the higher HF treatment. The seed of the HF treated plants also had a lower starch content, suggesting that the fluoride interfered with starch synthesis. The HF treatments had no apparent effects on the reducing sugars, total sugars, water soluble polysaccharides, protein, or ether extract of the bean seed. Seedlings grown from the HF affected seed showed delayed emergence and less vigorous growth than control seedlings. The cordate primary leaves were abnormally small and distorted. (Author abstract modified)

19703

Arndt, Uwe

CHANGES OF CONCENTRATION OF FREE AMINO ACIDS IN PLANTS UNDER THE INFLUENCE OF HYDROGEN FLUORIDE AND SULFUR DIOXIDE. (Konzentrationsaenderungen bei freien Aminosaeuren in Pflanzen unter dem Einfluss von Fluorwasserstoff und Schwefeldioxid). Text in German. Staub, Reinhaltung Luft, 30(6):256-259, June 1970. 26 refs.

After treating different types of plants for 14 days with air containing 6 micrograms of hydrogen fluoride/cu m or with air

containing 0.7 mg of sulfur dioxide/cu m, their contents of free amino acids were determined by two-dimensional chromatography and were compared with those of the control plants. The individual amino acids were identified with the aid of calibration curves prepared using commercially available amino acids. Analyses of damaged plants showed, in general, increases of concentration of the individual acids. The same result was obtained after treating grass with HF in which no external symptoms of damage were evident. Plants treated with SO2 and appearing undamaged, exhibited varying changes in concentrations of the individual amino acids, but there was also a trend towards higher total amino acid concentrations in this case. This suggests the possibility of utilizing the metabolic reactions investigated above as indicators of emission effects. To obtain a higher detection sensitivity of metabolic reactions, which are desirable as early indicators of emission effects, further studies are planned in which no extracts from the entire plant body but only those from certain cell complexes will be analyzed. This kind of sampling separates the various metabolic circuits from each other, which may react differently to the same emissions and, hence, lead one to expect more unequivocal results.

19713

AIR POLLUTION: PLANT KILLER. Environ. Sci. Technol., 4(8): 635-636, Aug. 1970.

Agricultural losses caused by increasing air pollution are estimated to reach $500 million annually in the U. S., most of the losses being due to growth suppression or plant injury. However, acute injury suggests the nature of the air pollutant and reveals the distribution of the problem. Visible effects of sulfur-dioxide injury are the bleaching of leaf areas to a light tan or ivory color or the complete bleaching of leaf. Injury from fluoride causes tissues to die at the margin and tip of the leaf. The dead tissues may be gray or light green at first, later becoming reddish-brown or tan. Typical patterns of ozone injury are bleached or light flecks or stipples on the upper surface of leaves. Injury from peroxyacetyl nitrate is characterized as glazing and browning of the lower leaf surfaces and attack of the younger leaves. A number of research programs are attempting to find a cure for pollution damage to vegetation. These programs include work on the development of crop species that are genetically resistant to atmospheric pollutants and on chemical compounds that would permit plant growth in polluted atmospheres.

19863

Mohamed, Aly H.

CYTOGENETIC EFFECTS OF HYDROGEN FLUORIDE ON PLANTS. Fluoride Quart. Repts., 2(2):76-84, April 1969. 8 refs.

Fluorocompounds, either organic or inorganic, are considered to be potential pollutants. These compounds are by-products of various industrial processes, such as the production of phosphate-fertilizers, ceramics, and certain metals such as aluminum. Gaseous hydrogen fluoride is one of the most phytotoxic of the halogen compounds occurring as air pollutants. Fluoride gas in the atmosphere may cause severe damage to plants, even when the concentration is below the level required to produce visible morphological symptoms. Experiments were conducted on tomato plants and maize to determine their reaction to fumigation with hydrogen fluoride gas. Chromosomal aberrations resulted in the tomato plants. Similar cytological results occurred in the maize. HF seems to affect primarily the DNA molecule by blocking its replication, probably through its action on the enzymatic system. (Author abstract modified)

19873

Garber, K.

EFFECTS OF FLUORINE. PERTAINING TO THE FLUORINE CONTENT OF PLANTS (1). (Fluor-Wirkungen) Federal Inst. of Applied Botany, Hamburg (West Germany), RR-14, p. 42-48, 1967. 10 refs. Translated from German. Belov and Associates, Denver, Colo., 8p., May 26, 1970. (Also: Qualitas Plant. Mater. Vegetabiles, 15(1):29-36, 1967.)

Several years of research on the fluorine content of plants in non-industrial regions have shown that the natural fluorine content may vary between 0.2 and 2.0 mg/100 g dry matter. The uptake of fluorine from the soil will continue independent of the fluorine content of the soil. From these investigations, it was concluded that fluorine contents higher than the natural values indicate the influence of fluorine emissions. The fluorine contents of various plants are presented in tabular form.

19949

Halbwachs, G.

INVESTIGATIONS ON DIRECTED ACTIVE FLOW AND MATERIAL TRANSPORT IN THE LEAF. Flora (Jena), vol. 153:358-372, 1963. Translated from German. Belov and Associates, Denver, Colo., 34p., Feb. 20, 1970.

Damage by acidic gases, such as sulfur dioxide, hydrochloric acid, and hydrogen fluoride, is expressed in leaves as irregular necrotic spots distributed across the entire leaf surface, or as localized necrosis at the leaf edges and tips. The acidic gases enter the interior of the leaf through the pore openings. Thus, their opening condition is of importance for the extent and speed of damage. Spot-shaped necroses appear in the direct area of the entry locations as a result of tissue damage from high concentrations. Edge and border damage occurs only at low concentrations, which are different for the individual acidic gases, depending on their toxicity. This localization of damage requires transporting the gases toward the leaf edges and tip, and an effective suction at these leaf parts. The existence of such a suction effect, which is significant with respect to the problem of water and substance distribution in the leaf, was made probably by experiments with cut branches, allowing them to absorb dilute HCl and sodium hydroxide solutions and chromium fluorides. The results showed that the preconditions for water and substance flow in the leaf are created by leaf pressure and evaporation, but that the finer distribution in the leaf is regulated by the leaf itself. (Author summary modified)

20015

Spencer, G. R., E. C. Stone, and D. F. Adams

FLUORIDES IN ANIMALS IN THE DALLESPORT AREA. Wash - State Univ. Agr. Exp. St., St. Circ., no. 353, 8p. 1959. 2 refs.

The natural levels of fluoride intake, storage, and excretion were determined in farm animals in the area of a new aluminim reduction factory, prior to start-up of the plant. In addition, the local prevalence of other diseases that might be confused with fluorosis were to be established. Animals and feeds in the Dallesport, Washington area of Klickitat Country and The Dalles, Oregon area had a normal fluoride level. Water from 13 ranches had from 0.05 to 1.26 ppm fluoride with a mean of 0.25. Hay from twelve ranches had from 0 to 8.3 ppm fluoride with a mean of 4.4. Analyses of urine, horn, hoof,

teeth, and bone from cattle (mostly beef) disclosed normal levels of excretion and storage. Physical examination of cattle on 11 ranches disclosed normal teeth in most individuals and only one case of lameness. It was concluded that no unusual or abnormally high sources of fluoride are available to the animals in the area. (Author summary modified)

20157

Van Brackle, Richard D.

THE FARMER'S STAKE IN AIR POLLUTION. Crop Soils Mag., 20(1):17-19, Oct. 1967.

The assessment of agricultural problems caused by air pollution is difficult, since air pollution injury is not easily distinquishable from insect or disease injury; pollution makes crops more susceptible to insects and disease; and some pollutants cause damage at very low concentrations and may not be suspected. The $15 million of visible damage done to crops in California does not include such factors as reduced vigor, longer growing season, extra water and fertilizer, and lowered quality. Photochemical air pollution is considered the most dangerous type for agriculture. More than 300 types of plants are affected by air pollution. the average California automobile is 5 1/2 years old, has had two owners, is driven approximately 9,000 miles per year and makes about one 25-mile trip per day; this results in a daily emission of 6 1/2 pounds of contaminants, which in turn results in a total figure for 1963 of 56 million pounds. Among the major pollutants that damage plant life are ozone, peroxyacetyl nitrate various types of fluorides, sulfur dioxide, and ethylene. Air pollution has had an adverse effect on agriculture for over a century.

20158

Zimmerman, P. W.

CHEMICALS INVOLVED IN AIR POLLUTION AND THEIR EFFECTS UPON VEGETATION. Proc. Governor's Conf. Exhibit Atmospheric Pollution, New Jersey, 1952, p. 23-31. 33 refs. (Feb. 19-20.)

Results of studies on the effects of various gases on plants are summarized for sulfur dioxide, hydrogen fluoride, chlorine, hydrogen sulfide, ammonia, mercury vapor, ethylene and carbon monoxide, and the vapors of 2,4-D and other hormone-type chemicals. Measurements of the atmosphere at Yonkers, New York, show an average of 0.01 ppm of SO2 for 62% of the year. A maximum concentration of 0.75 ppm occurred in January. Leaves of alfalfa and buckwheat exposed to a concentration of 0.40 ppm for 7 hours became spotted. Working with concentrations of 0.1-0.2 ppm of SO2, the following observations were made: there is more SO2 resistance at or below 40 F, and SO2 sensitivity does not change with minor variations in soil moisture. The sulfate content of the nutrient supply did not affect sensitivity, although the growth rate of sulfur-defficient plants increased under fumigation with 0.1-0.2 ppm SO2. Plants recover between treatments if these are sufficiently spaced. Sensitivity was not affected by wetting the leaf surface. Young plants are more resistant than old plants; older leaves are more resistant than younger ones. HF gas tends to injure the margin of the leaf more frequently than SO2. Application of sodium fluoride to soil caused similar injuries to those induced by HF fumigation H2S gas is less toxic than the other gases tested, and injured the younger rather than the older leaves. Substituted phenoxy acids are extremely selective, stimulating growth in some plants and injuring or deforming others.

20400

Adams, D. F. and C. W. Sulzbach

NITROGEN DEFICIENCY AND FLUORIDE SUSCEPTIBILITY OF BEAN SEEDLINGS. Science, vol. 133:1425-1426, May 5, 1961. 6 refs.

The influence of nutrition on the susceptibility of beans to visible foliar injury from atmospheric fluorides was studied. Groups of bean seedlings were grown concurrently in cleaned and fluoride-containing (4 to 7 micrograms/cu m) air in plant-growth chambers for 10 and 20 days with six water-culture treatments: Hoaglund's formulation and Hoaglund's minus potassium, calcium, nitrogen, phosphorus, and iron. An inadvertent 15-hour exposure on day 15 (at 42 micrograms/cu m) produced foliar fluorosis symptoms only on the nitrogen-deficient plants fumigated 20 days, although higher fluoride concentrations were present in the foliage of similar plants grown in the other nutrient-deficient solutions. Thus it appears that production of necrosis, within a single variety, is not solely related to the fluoride concentration in the tissue and that fluoride susceptibility must therefore be biochemically associated with other metabolic processes in mechanisms which remain to be elucidated. (Author abstract modified)

20476

Schoenbeck, Helfried

A METHOD FOR DETERMINING THE BIOLOGICAL EFFECTS OF AIR POLLUTION BY TRANSPLANTED LICHENS. Staub (English translation from German of: Staub, Reinhaltung Luft), 29(1):17-21, Jan. 1969. 21 refs.

A method for transplanting the leaf lichen Parmelia physodes for use as an indicator of various air pollutants is described. This type of lichen is relatively indifferent to its base; its natural ecological conditions can be disregarded for at least six months, and the medium into which the lichen and its substrate are transplanted has little significance over an even longer period. The method entails removing the lichen from the tree (preferably oak), transplanting it into exposure boards of wood or other material, exposing the lichen in the area being investigated at a height of 1.5 m, recording withering effects (manifested by color changes) photographically, and grading the intensity of damage. The method is expected to simplify and reduce costs of certain air quality measurements, especially for sulfur dioxide and fluorine emissions, and also indicate changes in air quality due to such conditions as wind direction.

20573

Kaudy, J. C. F. T. Bingham, R. C. McColloch, G. F. Liebig, and A. P. Vanselow

CONTAMINATION OF CITRUS FOLIAGE BY FLUORINE FROM AIR POLLUTION IN MAJOR CALIFORNIA CITRUS AREAS. Proc. Am. Soc. Hort. Sci., vol. 65:121-127, 1954. 22 refs.

As a preliminary phase of an investigation of the effect of fluorine on citrus growth, the extent of fluorine contamination in citrus foliage was determined. Leaves from approximately 130 citrus groves, collected in both heavily polluted areas and areas far removed from pollution, were analyzed for fluorine. Citrus leaves from the Coachella Valley of Riverside County, and from San Diego, Ventura, and Tulare counties disclosed concentrations of 1 ppm F or less. Leaves collected in industrialized areas disclosed values up to 211 ppm F. The greatest fluorine accumulation was evident in leaves from the San Bernardino Valley, San Bernardino County, especially from the vicinity of Fontana, where a steel plant is located. Signifi-

cantly elevated accumulations were also found in leaves from the Los Angeles area, presumably as a result of emissions from aluminum, ceramic, phosphate, and chemical plants. Elevated fluorine values were not associated with any visible damage to the trees. Sampling of leaves of 12 groves over a 9-month period disclosed a maximum accumulation of fluorine during the summer and fall months. Foliar concentrations of fluorine increased very little, once the winter rains began. (Author summary modified)

20690

Shupe, James L.

FLUORINE TOXICOSIS AND INDUSTRY. Am. Ind. Hyg. Assoc. J., 31(2):240-247, March-April 1970. 10 refs.

Fluorosis in livestock can be accurately diagnosed and controlled when the complexity of the disease is realized, and the symptomatology, pathogenesis, and lesions are properly correlated, interpreted, and evaluated. Tooth classification and the amount of fluorine in bone can be used to diagnose and evaluate the degree of fluorosis with a high degree of accuracy. Some products can counteract and lessen the potential damage that ingested fluorides can cause. Aluminum sulfate, aluminum chloride, calcium aluminate, calcium carbonate, and defluorinated phosphate can reduce the toxicity of fluorine in animals. Multiple correlation formulas useful in diagnosing fluorosis, and livestock fluorine tolerances are included in tabular form. A comprehensive guide is also presented which facilitates diagnosing and evaluating fluorosis. (Author conclusion modified)

20707

Hasegawa, T. and H. Yoshikawa

ON THE ATMOSPHERIC FLUORIDE POLLUTION. PART I. (Fukkabutsu ni yoru taiki osen chosa (1)). Text in Japanese. Taiki Osen Kenkyu (J. Japan Soc. Air Pollution), 4(1):147, 1969. (Proceedings of the 10th Annual Meeting of the Japan Society of Air Pollution, 1969.) PART II. Ibid., 4(1):148, 1969.

Fluorine compounds emitted from chemical fertilizer, ceramics, and chemical industries were suspected to be the cause of death of 70 oxen for agricultural use between 1953 and 1964 in the outskirts of Osaka. Fluoride analysis was conducted on the urine of Japanese oxen in the area in order to determine the extent to which fluorides in air enter grass and feed. Fluoride content was found to be as high as 20 ppm. Further investigation was performed in order to determine the relationship between the fluorine compound content in the bones of the dead oxen and dust fall, plants, animal feed, and soil characteristics. A substantial amount of fluorides was discovered in the bones, and it became apparent that the compounds originated from the factories. It was not obvious whether they were the direct cause of death, because some inorganic fluorine compounds do not lead to death even at high concentrations. Since the oxen were also used for ploughing the fields, conclusions could not be drawn as to the real effects of the fluorides on the animals.

20708

Hasegawa, T. and Y. Yamazaki

ON THE ATMOSPHERIC FLUORIDE POLLUTION. PART II. (Fukkabutsu ni yoru taiki osen chosa (2)). Text in Japanese. Taiki Osen Kenkyu (J. Japan Soc. Air Pollution), 4(1):148, 1969. (Proceedings of the 10th Annual Meeting of the Japan Society of Air Pollution, 1969.) PART I. Ibid., 4(1):147, 1969.

In East Osaka, agricultural crops either died or showed poor growth in the neighborhood of a factory producing white cosmetic bottles. Since fluorite was used as a material and there was no damage before the establishment of the factory, it was suspected that fluorine compounds were causing the damage. Quantitative analysis was performed on the agricultural crops and the exhaust gas as well as the dust particles in order to determine the fluorine content. Gas samplers were used to collect the dusts from the surrounding atmosphere. Fluorine content of dust near the factory was on the average about 93 mg per cubic meter per day, and in some parts, as high as 1.54 mg per cubic meter per day. Relatively larger quantities of fluorine were measured at the southwestern and southeastern area of the factory, corresponding to the general wind pattern. Rice and soy beans from the neighborhood of the factory showed concentrations of fluorine and, especially in the leaves of the damage crops, the concentrations were several hundred times higher than those of the undamaged leaves.

20872

Rippel, A

LONG TERM EFFECT OF FLUORIDE EMISSIONS UPON VEGETATION. Fluoride Quarterly, J. Intern. Soc. Fluoride Res., 3(1):18-21, Jan. 1970. 7 refs.

The results are presented of an eight-year study of the fluoride content of fruit, vegetables, and grain grown in four communities near a Czechoslovak aluminum factory. In the community nearest the factory, the fluoride levels in fruit and grain were five and six times higher, respectively, than those of controls. However, the fluoride levels in grain were only 2.6 times as high as in the controls. Root vegetables, especially potatoes, exhibited only minor changes in fluoride content, suggesting that fluoride uptake by plants is independent of fluoride levels in soil. In tuberous vegetables, fluoride accumulated in the portions of the plants growing above ground rather than in the tubers. This fact points to fluoride uptake from the air. The fluoride levels observed after the long-term exposure of plants were above normal. Fruit trees deteriorated progressively, particularly the sensitive plum trees and grape vines. The long-term emissions also distinctly decreased the biological and organoleptic values of the agricultural product and the productivity of agricultural plants.

20874

Jacobson, Jay S. and D. C. McCune

INTERLABORATORY STUDY OF ANALYTICAL TECHNIQUES FOR FLUORINE IN VEGETATION. J. Assoc. Offic. Anal. Chemists, vol. 52:894-899, Sept. 1969. 21 refs. (Presented at the 60th Annual Meeting of the Air Pollution Control Association, Cleveland, Ohio, June 14, 1967.)

An interlaboratory study of fluorine analyses on plant tissues was performed to determine the current levels of within- and between- laboratory precision. Homogeneous, ground, fluorine-containing leaf tissues of alfalfa, citrus, gladiolus, pine, and orchard grass were analyzed by the routine methods currently in use in 31 different laboratories. The data reported by the laboratories are summarized. The mean values obtained for each tissue are as follows: alfalfa, 53.2 ppm; citrus, 117.5 ppm; gladiolus, 54.0 ppm, pine, 74.4 ppm; and orchard grass, 55.3 ppm. The variation between laboratories was estimated by calculating standard deviations, which ranged from 11.0 ppm for alfalfa to 14.0 ppm for citrus tissues. Relative standard deviations ranged from 12.7% for citrus to 24.5% for gladiolus. Deviations between the fluorine content of paired samples provide estimates of within- laboratory reproducibility. Some laboratories obtained highly reproducible results, but 14 reported at least one pair of duplicate values which differed

from each other by 10 ppm or more. The results show that, despite the use of generally similar methods, there are marked differences in procedures, techniques, and reagents from laboratory to laboratory. A marked improvement in agreement is urgently needed to improve the usefulness of current fluorine measurements.

20917

Garber, K.

FLUORIDE IN RAINWATER AND VEGETATION. Fluoride Quarterly, J. Intern. Soc. Fluoride Res., 3(1):22-26, Jan. 1970. 5 refs.

Fluoride levels of rainwater in industrial areas of Germany ranged from 0.28 mg/l to 14.1 mg/l, depending on the kind of industry, the distance from industrial complexes, and the extent to which coal was used. Fluoride assays of various plant species showed the same trend as those in rainwater; the fluoride content of the plants increased with increased fluoride levels of air. In a hothouse experiment, plants grown in soil from the contaminated areas exhibited fluoride levels only four times higher than those in control plants. In contrast, plants exposed to airborne fluoride near a factory showed 22- to 200-fold increases in fluoride values. Even when fluoride levels in rainwater were only 10 times higher than normal, plants cultivated near rainwater testing stations were markedly damaged by fluoride emissions, suggesting that high concentrations of fluoride compounds entered the plants during brief, short-term exposures.

21000

McCune, D. C., L. H. Weinstein, and Jill F. Mancini

EFFECTS OF HYDROGEN FLUORIDE ON THE ACID-SOLUBLE NUCLEOTIDE METABOLISM OF PLANTS. Contrib. Boyce Thompson Inst., 24(19):213-225, Jan.-March 1970. 26 refs. (Presented at the Air Pollution Control Association 60th Annual Meeting, Cleveland, Ohio, June 11-16, 1967.)

Experiments were undertaken to explore the problem of fluoride effects on phosphorus metabolism in reference to acid-soluble nucleotides in 'Tendergreen' and 'Pinto' beans, 'Bonny Best' tomatoes, and 'Marcross' corn. Procedures and methods are described for six distinct experiments. Hydrogen fluoride (HF) in the atmosphere at concentrations of 4.8 to 10.7 mg Fluorine/cu m for periods of 4 to 12 days had no consistent effect on the levels or compostion of acid-soluble nucleotide pools in leaves of the plants. The distribution of phosphorus (P) among the various nucleotide fractions was not affected by HF fumigation, but the incorporation of P by the whole-acid soluble nucleotide pool was reduced in corn leaves. In general, there was less apparent effect on the metabolism of acid-soluble nucleotides by HF exposure than has been reported for other metabolic systems of the plants. (Author abstract modified)

21062

Sobocky, E.

PRELIMINARY RESULTS OF ECONOMIC AND SYLVICULTURAL MEASURES AGAINST THE EFFECTS OF FLUORINE IN THE REGION OF ZIAR N.HRONOM. (Predbezne vysledky lesnickohospodarskych opatreni proti pusobeni fluoru v oblasti Ziaru n.Hronom). Scientific and Technical Society, Prague (Czechoslovakia), Agriculture and Forestry Section, Proc. Conf. Effect Ind. Emissions Forestry, Janske Lazne, Czechoslovakia, 1966, 10 refs. (Oct. 11-14.) Translated from Czech. Franklin Inst. Research Labs., Philadelphia, Pa., Science Info. Services, p. XIII-1 to XIII-13. April 24, 1969.

Results of research and sylvicultural and economic measures taken to reduce the harmful effects of emissions in the area of Ziar N.Hronom were summarized. The source of the emissions was a metallurgical plant producing aluminum. The sylvicultural measures were first directed toward the most severely attacked zone I of the area, and on non-sylvan areas, which were not used to grow trees, located within the reach of the maximum smoke attack between the forest boundary and the plant. In zone I, practically all degrees of injury were found, starting with depigmentation and necrosis formation in assimilation organs, up to the loss of foliage and decay of conifers. From among four-year plants on unforested land, which were subjected to various cultivation operations including mineral fertilization, best results were obtained for black alder, birch, red oak, pedunculate oak, and Austrian pine. Fertilization with lime and ground Thomas slag proved efficient only in the case of black alder. A much better result was provided by hoeing and mowing. Successful foresting depends not only on exposure to the emitting source, but also on a lower HF concentration. Terrian relief creates a natural barrier to penetrating emissions. The beech stand, situated 2110 m eastward of the emitting source, reduced the detrimental effect of HF in its above surface layer by approximately 30% in comparison to a free area in front of the stand boundary. A ten-year pine culture, 1950 m south-southeast from the source, reduced the harmful effect of HF by approximately 50% by comparison to total clearing, and thus fulfilled the protective function by being in front of the sheltered trees.

21093

Thompson, C. R.

EFFECTS OF AIR POLLUTANTS ON LEMONS AND NAVEL ORANGES. Calif. Agr., 22(9):2-3, 1968.

Lemon trees were divided into 6 groups of four, and each group received an experimental treatment of an atmospheric phytotoxicant previous to water use determination. Activated carbon filters removed ozone and peroxyacyl nitrates, both components of photochemical smog; limestone removed acid fluoride gases, such as hydrogen fluoride; and nitric oxide reacted to remove ozone. Levels of total oxidants, fluoride, and temperatures in the air were recorded continuously. Trees receiving filtered air required more extra irrigation than those with ambient air, and trees receiving filtered air and filtered air plus fluoride had a higher rate of apparent photosynthesis than those receiving ambient air. Preliminary evaluation indicates that trees which get ambient air have an increased leaf drop (up to 30%) and yield less fruit than trees which receive carbon-filtered air.

21189

Shikenjo, Norinsho Sanshi

AIR POLLUTION AND SERICULTURE. (Taikiosen to yosan-sogo shoroku). Text in Japanese. Sanshi Shikensho Shiryo (J. Sericultural Experiment Station), no. 20:102p., April 1966. 518 refs.

Various types of sericulture damage by atmospheric pollutants are considered in terms of responsible sources, in addition to the effects of the pollutants on mulberry leaves and silk worms. Damages are classified as follows: (1) sericulture damage due to gaseous, solid, and liquid wastes, the major contaminants of which are sulfur dioxide, hydrogen fluoride gas, chlorine gas, smoke dusts, and aerosols; (2) damage due to stack smokes generated by charcoal burning, heavy-oil burning, the skyrocket type of fireworks, and rubber-tire burning; (3) damage due to motor vehicle exhaust gas, dust clouds, mud, and mire; (4) damage due to aerially sprayed agricultural chemicals; (5) damage due to irradiated substances; (6) damage

due to volcanic ashes; (7) damage due to salt-containing sea wind; (8) and damage due tc hazardous substances, such as nicotine, contained in tobacco plants cultivated on adjacent farms or to other hazardous plants and crops such as pyrethrum, Picrasima quassioides Benn, bindweed, and peppermint. A bibilography is provided in which references are classified according to specific sources and their respective effects on both mulberry trees and silkworms.

21194

Kuribayashi, Shigeharu

INJURY OF MULBERRY TREES BY AIR POLLUTION. (Talkiosen ni yoru yoso no higai). Text in Japanese. Sanshi Kagaku to Gijutsu (Sericultural Sci. Technol.), 8(8):64-67, Dec. 1969.

Atmospheric pollutants and their effects on mulberry leaves are discussed. At present the diagnosis of the effect of air pollution is largely dependent on chemical analysis and observations of the growth of mulberry trees and of silkworms, together with simultaneous analysis of atmospheric and soil samples. In observing symptoms of injury, it is important to remember that some symptoms may be transient or analogous to those caused by insects or fertilizers. For this reason, a comparative study of injured and healthy leaves should be undertaken to determine the level of injury and the responsible sources. The types of injuries caused by different pollutants are outlined. Dechlorized and spotted leaves are representative of the effect of 0.1-0.2 ppm, or higher concentrations of silkworms fed these leaves initially show loss of appetite, then inhibited growth, and finally death. The visible symptoms produced by 150-200 ppm hydrogen fluoride gas are brown spots at leaf tips and edges. Levels half as low are sufficient to kill silk. Silkworms leaves injured by chlorine gas also show decreased appetite and sometimes vomit silk thread. Gaseous contaminants containing stack smoke and carbon particles are generally sticky, insolubile in water, and extremely detrimental to the growth of mulberry trees. The effect of dusts and suspended particles from adjacent plants varies according to size and components.

21364

Noble, Wilfred

SMOG. Lasca Leaves, 15(1):1-24, 1965. 20 refs.

The various effects that smog has on plants in the Los Angeles area, and the effects of particular pollutants are discussed. One of the chief characteristics of pollution in this area is its high ozone concentration and the resulting strong oxidizing ability. Some of the components of this pollution has been determined. Peroxyacetyl nitrate (PAN) has been shown to cause silvering, banding, growth reduction, and cellular collapse. Ozone primarily attacks the older leaves and particularly affects woody plants. In contrast to PAN, which attacks the lower leaf surface, ozone affects the palisade layer of the upper surface, causing small clusters of cells to darken and eventually turn brown-black. Only orchids and carnations have shown serious injury due to ethylene. The gas causes dry sepal on orchids. In carnations, the opened blossom reverts back to a bud, and effect called 'sleepiness'. Fluorides are cumulative when absorbed by plants and translocated within the plant, concentrating in the tips and edges of leaves. There they cause a cocoa brown discoloration with well defined borders. Acute injury from sulfur dioxide appears as a tan to white area between the veins, with most severe symptoms appearing on the younger leaves. Presently, not much is known about the effects of nitrogen oxides on plants. After considerable study, it was determined that the only satisfactory means for growing undamaged plants was to filter air through activated carbon. A study of air pollution using plant indicators is also discussed.

21422

Schoenbeck, H., M. Buck, H. van Haut, and G. Scholl

BIOLOGIC AIR POLLUTION MEASUREMENT METHODS. (Biologische Messverfahren fuer Luftverunreinigungen). Text in German. VDI (Ver. Deut. Ingr.) Ber., no. 149:225-234, 1970. 49 refs.

Plants can be used as indicators for air pollution. Test plants grown under comparable conditions in various distances from the emission source help to detect not only the type of pollutant causing injuries but also the effect of dust sediments in the soil. This method used in the vicinity of a zinc smelting plant revealed that sulfur, zinc, and lead containing emissions caused the observed plant injuries. Lolium multiflorum and L. perenne growth in synthetic pots and set up at various distances from a fluorine emitting plant provided indication of the quanities emitted at each point. Transportable plexiglass chambers can be used as covers for the plants at greatly different climatic conditions among the various exposure sites. Filtered and unfiltered air is drawn into the chambers. Apart from higher plants, lower epiphytic organisms such as lichens or moss can be used as indicators for air pollution. The widely spread parmelia physodes can be transplanted onto carrier plates and exposed. A clear relationship between the growth rate of these lichens and the SO2 and HF concentration of the ambient air could be found.

21498

Chang, Chong W.

EFFECT OF FLUORIDE ON NUCLEOTIDES AND RIBONUCLEIC ACID IN GERMINATING CORN SEEDLING ROOTS. Plants Physiol., 43(5):669-674, May 1968. 24 refs.

An investigation was made to determine the effect of fluoride on plant growth, acid soluble nucleotides, and RNA in germinating corn seedling roots. Fluoride suppressed root growth to a range of two-thirds to one-third the control value depending on fluoride concentration. The rate of growth inhibition was positively related to fluoride content. Column chromatographic analyses demonstrated that fluoride modified ratios of acid soluble nucleotide species. The relative amount of nucleotides is altered mainly due to triphosphate nucleotides of which ATP is most accumulated. Paper chromatographic analyses showed that fluoride induces changes of RNA structure. It is characterized by lowered relative content of cytosine, and by an increased ratio of cytosine to guanine. Adenine is depressed only in the root tissue treated by the highest fluoride concentration (Author abstract modified)

21500

NcNulty, I. B. and D. W. Newman

MECHANISM(S) OF FLUORIDE INDUCED CHLOROSIS. Plant Physiol. 36(4):385-388, July 1961. 17 refs.

An investigation was conducted to elucidate the mechanism of action of fluoride-induced chlorosis. Leaf tissue was cultured in a calcium-free mineral nutrient solution, with and without fluoride, under constant light and temperature. Analyses were made on the chlorophylls, photochlorophylls, carotenes, and ether soluble magnesium compounds. Sodium fluoride prevented the accumulation of chlorophyll a, chlorophyll b, and photochlorophyll in bean leaves. However, the photochlorophyll to chlorophyll a transformation was not affected. The chlorphylls, the carotenes, and total ether soluble magnesium containing compounds were all affected propor-

tionately. The similarity in total ether-soluble-magnesium containing compounds indicates there was no inhibiton of pigment synthesis following the attachment of the magnesium atom to the ring structure. These results suggest that the inhibition of pigment synthesis must occur very early in the synthesis of pigment components, or with some phase of basic metabolism necessary for their synthesis. The apparent dissolution of chloroplast structure that occurs concurrently with the appearance of chlorosis could explain the similarity in decrease of all pigments. Thus, fluorides may affect the early stages of pigment synthesis, or induce the degradation of chloroplast structure. (Author summary modified)

21501

Threshow, Michael, Gerald Dean, and Frances M. Harner

STIMULATION ON TOBACCO MOSAIC VIRUS-INDUCED LESIONS ON BEAN BY FLUORIDE. Phytopathology, vol. (57):756-758, July 1967. 4 refs.

The possible effect of fluoride on the number of local lesions developing on Pinto bean leaves following inoculation with tobacco mosaic virus was studied. Plants were grown in fumigation chambers where atmospheric fluoride concentrations ranged from 0.2 to 2.5 micrograms/ cu m; foliar fluoride concentrations ranged from 20 to 637 ppm. The number of lesions increased with foliar fluoride concentrations up to 500 ppm, above which the number decreased. Lesion numbers on plants in the unfumigated chambers served as a control, and these values represented 100%. The lesion numbers on leaves with fluoride concentration of 100-200, 200-300, 300-500 ppm were 121%, 157%, and 179%, respectively. When lesion numbers were grouped according to leaf age, lesions were most prevalent on the first trifoliolate leaves. The number of lesions decreased on older leaves and plants. When leaves were fully developed and plants had reached the four- to five-leaf stage, no lesions could be induced. (Author abstract modified)

21687

Treshow, Michael and Merrill R. Pack

FLUORIDE. In: Recognition of Air Pollution Injury to Vegetation: A Pictorial Atlas. Jay S. Jacobson and A. Clyde Hill (eds.), Pittsburgh, Pa., Air Pollution Control Assoc., 1970, p. D1-D17. 29 refs.

The damaging effects of fluoride on plant foliage, flowers, and fruits are discussed. Fluoride injury results from the gradual accumulation of fluroide in the plant tissue over a period of time. Therefore, the duration and the atmospheric concentrations are important in determining the severity of injury. Different plant species, varieties or clones of a single variety, and plants from different seed lots differ in their susceptibility to fluoride. A list of some common plant species, which are sensitive to fluoride, is presented in tabular form. The characteristic sympton of fluoride injury on many broad-leaved plants is necrosis, which occurs primarily at the leaf tips and margins where the fluoride has accumulated. This symptom is seen in apricot, gladiolus, European grape, and conifers. Fluoride sometimes causes a distinctive injury symptom in lilacs. A reddish-purple discoloration develops along the leaf margins and extends into a mottled reddish pattern between the veins. More severe injury results in chlorosis and necrosis. Fluoride also causes chlorosis in citrus, popular, sweet cherry, and corn. Fluoride injury results in marginal necrosis of the petals and sepals of flowers, and in soft suture in some fruits.

22084

Compton, O. C., L. F. Remmert, and W. M. Mellenthin

FLUORINE LEVELS IN CROPS OF THE DALLES AREA IN 1962 AND 1963. Oregon Agricultural Experiment Station, Corvallis, Special Rept. 187, 37p., 1965. 8 refs.

The fluorine content of forage or foliage of alfalfa, apricot, sweet and sour cherry, grape, peach, and prune crops grown in The Dalles area in Oregon in 1962, and of alfalfa, cherry, and peach crops in 1963 are reported. These data are compared to similar data obtained periodically since 1953. Leaf samples collected in July 1962 ranged from 4 to 362 ppm fluorine, averaging 31 ppm. Samples collected in October ranged from 17 to 474 ppm, averaging 92 ppm. Similar samples from the Corvallis area had less than 15 ppm fluorine. Alfalfa forages from The Dalles area averaged 31 ppm in July and 81 ppm in October with maximums of 84 and 166 ppm, respectively. A marginal necrosis chamcteristic of fluoride injury was found on apricot leaves, with the weaker trees showing the most severe injury. In June 1963, sweet cherry leaf samples ranged from 4 to 34 ppm, averaging 13 ppm fluorine, while those collected in September ranged from 9 to 72 ppm, averaging 22 ppm. Similar samples taken in July and October 1963 averaged 32 and 95 ppm, respectively. Fluorine in the air was determined on a few samples in 1963. The amounts varied from none to 12.9 micrograms fluorine/cu m of air varying with the location and season. The data are insufficient to relate air and foliage fluoride. (Author summary modified)

22085

Compton, O. C., L. F. Remmert, and W. M. Mellenthin

FLUORINE LEVELS IN CROPS OF THE DALLES AREA IN 1964. Oregon Agricultural Experiment Station, Corvallis, Special Rept. 204, 21p., 1965. 5 refs.

In 1964, the fluorine content of sweet cherry leaf samples collected in July ranged from 4 to 31 ppm, averaging 11 ppm. Samples collected in September contained from 6 to 52 ppm fluorine, averaging 19 ppm. The data for peach trees were similar. Even though these fluorine levels were much lower than in 1960-62, the effect of distance and direction from the aluminum reduction factory is evident. There was no discernible trend in fluorine levels because of location within The Dalles area before the opeation of the factory. Fluorine samples from the air varied from none to 2.5 micrograms/cu m of air. The relationship between the fluorine in the air and in foliage of Royal Ann cherry trees indicated that the higher the air fluorine, the greater was the leaf fluorine content. (Author summary modified)

22092

Compton, O. C., L. F. Remmert, and W. M. Mellenthin

FLUORINE LEVELS IN 1961 CROPS OF THE DALLES AREA. Oregon Agricultural Experiment Station, Corvallis, Special Rept. 153, 25p., 1963. 6 refs.

The fluorine content of the foliage or forage of alfalfa, apricot, cherry, sour cherry, grape, peach, and prune crops grown in The Dalles area in Oregon during 1961 are reported. These data are compared, in tabular form, to similar data obtained previously. Leaf samples collected from the crops in July 1961 ranged from 12 ppm to 217 ppm fluorine, averaging 65 ppm. Samples taken in September ranged from 16 to 204 ppm, averaging 68 ppm fluorine. Leaf Scorch on apricot trees and soft suture on peaches were observed. These conditions were noted in 1959 and 1960, but not before the operation of an aluminum factory located in this area. The effects of calcium chloride and fluoride spray treatments were also investigated. (Author summary modified)

22284

Solberg, Richard A. and Donald F. Adams

HISTOLOGICAL RESPONSES OF SOME PLANT LEAVES TO HYDROGEN FLUORIDE AND SULFUR DIOXIDE. Am. J. Botany, vol. 43:755-760, Dec. 1956. 20 refs.

The effects of hydrogen fluoride and sulfur dioxide on plant leaves were investigated. Morpark apricot, Italian prune, and Winesap apple trees were fumigated eight hours daily, five days per week, at 5 ppb HF. Pinto bean and tomato seedlings were fumigated with 0.5 ppm SO2 and 5 ppb HF. Fumigations with a mixture of HF and SO2 were conducted with the same concentrations in combination. Samples of injured and control leaves were processed microtechnically and examined microscopically. Histological responses to HF and SO2 were indistinguishable. Microscopic injury was first apparent in the spongy mesophyll cells and the lower epidermal cells. The mesophyll cells were readily injured and the most common degree of injury was total collapse; the lower epidermal cells were observed to distort and collapse when the mesophyll cells did. Disintegration of the chloroplasts occurs in those cells injured by HF and SO2 before complete collapse of all the leaf tissues occurs. Various postulates are discussed concerning the means and pathways by which a phytotoxic air pollutant may enter the leaf and produce injury.

22496

Kazantseva, E. N.

ASSORTMENTS OF GAS-RESISTANT LAWN GRASSES. In: American Institute of Crop Ecology Survey of USSR Air Pollution Literature. Effects and Symptoms of Air Pollutes on Vegetation; Resistance and Susceptibility of Different Plant Species in Various Habitats, In Relation to Plant Utilization for Shelter Belts and as Biological Indicators. M. Y. Nuttonson (ed.), vol. 2, Silver Spring, Md., American Institute of Crop Ecology, 1969, p. 50-55. (Also: Tr. Inst. Ekologii Rasteniy Zhivotnyhk (Sverdlovsk), vol. 54:91-95, 1967.)

Investigations concerning the gas resistance of lawn grasses were conducted at a Ural aluminum plant where fluorine pollution is present. Photosynthesis and the water regimen were studied in meadow fescue, red fescue, Kentucky bluegrass, red top, and timothy grass. Damage was observed in early spring when the leaves were appearing. There was burn on the tips of the leaves; then spotting and blotching appeared. The damage increased and reached a peak toward the end of the growing season. The smallest percentage of damage was observed on meadow fescue, red fescue, and Kentucky bluegrass, while the greatest damage was found on red top and timothy grass. Fluorine compounds decreased photosynthesis, water-holding capacity, and the quantity of free water. Slightly damaged species have a lower photosynthetic intensity, greater water-holding capacity, and more free water than the severely damaged grasses. Meadow fescue, red fescue, and Kentucky bluegrass are recommended for industrial sectors with severe fluorine pollution. Red top, 'regneria', Awnless bromegrass, and timothy grass are suggested for sectors with little pollution.

22499

Poovaiah, B. W. and H. H. Wiebe

TYLOSIS FORMATION IN RESPONSE TO FLUORIDE FUMIGATION OF LEAVES. Phytopathology, vol. 59:518-519, April 1969. 6 refs.

Occurrence of tyloses in the petiole of geranium plants fumigated with fluoride gives evidence that injury may influence function of tissues some distance from the actual site of visible damage. In the early stages of hydrogen fluoride fumigation, light brown colored areas appeared at thzeee white margins of leaves; these bec necrotic zones as the fumigation was prolonged. Intermediate-age leaves were injured more severely than either younger or older leaves. All tissues were affected in severely injured edges, although some upper epidermal cells still appeared nearly normal. In the zone adjacent to the severely injured area, the upper half of the leaf was normal, while the spongy mesophyll cells became plasmolyzed and collapsed. Distortion of chloroplasts and starch grains was noted in parenchyma cells near the injured area. Severely injured and necrotic regions stained very heavily with safranin. The first occurrence of injury in the spongy mesophyll is consistent with the suggestion that fluoride enters mainly through the stomata. Fluoride effects are more evident in the vascular region than other areas, and it is possible that the fluoride damage produces early senescence that in turn causes the tyloses to form. In the phloem, cylinder-like depositions were noted on sieve plates which were identified as callose by strong fluorescence when stained with aniline blue and illuminated with ultraviolet light.

22624

Garber, K., R. Guderian, and H. Stratmann

INVESTIGATIONS OF THE UPTAKE OF FLUORINE BY PLANTS FROM THE SOIL. (Untersuchungen uber die Aufnahme von Fluor aus dem Boden Durch Pflanzen). Qualitas Plant. Mater. Vegetabiles, vol. 14:223-236, 1967. 9 refs. Translated from German. Belov and Associates, Denver, Colo., 24p., May 30, 1970.

Experiments were conducted with different soil types to determine the fluorine uptake by plants from the soil. Indentical plant species showed different fluorine contents on different soils, and there was no correlation between the F-values in the soils. Additions of sodium and calcium fluoride of 5 mg F per 100 g soil (F mg%) to the soil had no effect on the F-level of the plants. Some one year old plants indicated necrosis and discoloration, especially at the leaf tips, and a decrease in yield which was stronger for soil with CaF2-additions. The uptake of fluorine, necrosis, discoloration, and decreased yield were more pronounced on sandy soil than on marshy or clay soils. Equal amounts of fluoride when added in one portion had a more damaging effect on the growth of Tradescantia and tomato than when added in three partial portions. The addition of NaF to oats in one portion before seeding had no effect on the F-content, but experiments with gradual additions showed a strong increase of the F-value. Soils taken from regions with flourine emissions were used to grow beans. The increased F-level in the beans is considered as proof that fluorine emissions act directly on the plant parts above the soil, and indirectly through the soil. (Author summary modified)

22789

Coleman, Charles H.

HOW PLANTS TEST AIR. Org. Gardening Farming, 1961:71-78, March 1961.

Although laboratory tests tell when phytotoxicants are present in the atmosphere, only plants will tell when they combine to form fog-burn contaminant injurious to crops. Moreover, in many instances, plants provide the first warning of early air pollution. The reliance scientists place on plant indicators is exemplified by a San Francisco program in which plant data is fed into electronic machines to determine the extent and origin of pollution damage. Plants susceptible to air pollution are listed and the effects of oxidants, ozone, fluorides, sulfur dioxide, ethylene, smog, and herbicides on plants are summarized. It is noted that air pollution damage to crops is $7 1/2

billion per year and that plants will become increasingly important for monitoring pollutants.

22887

Miller, Vernon L.

THE EFFECT OF ATMOSPHERIC FLUORIDE ON WASHINGTON AGRICULTURE. In: Air Pollution. Louis C. McCabe (ed.), New York, McGraw-Hill Book Co., Inc., 1952, Chapt. 11, p. 116-122. 7 refs.

A variety of studies on fluorides and vegetation are briefly reported. A new disease of the gladiolus Italian prune, characterized by brown, marginal leaf scorch and premature defoliation, is caused by industrial fluoride emissions. Fluorine scorch of gladiolus may be controlled by lime sprays under field conditions, and early results suggest that some varieties of gladiolus may serve as indicator plants in areas where fluoric effluents are a factor. Fluorosis of cattle in Washington was diagnosed, caused by ingestion of forage containing fluoride from air pollution. Extensive research is in progress on a number of possible causes of the ponderosa pine blight, including air pollution, climatic factors, insect damage, and fungus diseases; conclusive results are not yet available.

22930

Bulgakov, M. V.

AN EXPERIMENT IN CREATING PROTECTIVE PLANTINGS IN THE CITY OF KRASNOURAL'SK. In: American Institute of Crop Ecology Survey of USSR Air Pollution Literature. Effects and Symptoms of Air Pollutes on Vegetation; Resistance and Susceptibility of Different Plant Species in Various Habitats, In Relation to Plant Utilization for Shelter Belts and as Biological Indicators. M. Y. Nuttonson (ed.), vol. 2, Silver Spring, Md., American Institute of Crop Ecology, 1969, p. 79-84. (Also: Akad. Nauk SSSR Ural. Filial. Ural. Gos. Univ. Im. A. M. Gor'kogo. Okhrana prirody na Urale (Sverdlovsk), vol. 4:189-195, 1964.)

Krasnoural'sk is a large center of copper smelting and chemical industry in the Central Urals. Large amounts of sulfur dioxide and fluorine, which are harmful to vegetation and man, are discharged to the atmosphere. The local natural forest was destroyed by SO2, and as a result the city became unattractive and dusty. An arboreal nursery was established to aid in the selection of trees and shrubs adapted to local environmental conditions. An assortment of gas-resistant species for city plantings was developed, including poplar, birch, cedar, larch, maple, elm, Siberian pea shrub, elder, dogwood, sweetbrier, and others. Siberian pea shrubs from the local nursery and from another nursery were planted in a city park. The leaves on the plants from the local nursery remained normal in appearance, while those from the other nursery were severely damaged by SO2. This confirms the fact that the trees and shrubs for gas-polluted areas should be exclusively local, raised in the same noxious medium where they are to continue their growth. If frost-resistance is also desired, the plants should be raised under rigorous, spartan conditions. The establishment of parks and plazas, and the great number of trees and shrubs along the streets have made the air of the city cleaner and resulted in a milder microclimate.

23188

Amirov, R. O. and A. R. Ismaylov

INDUSTRIAL WASTES OF THE CITIES OF BAKU AND SUMGAIT AND THEIR EFFECT ON GREEN PLANTINGS. In: American Institute of Crop Ecology Survey of USSR Air Pollution Literature. Effects and Symptoms of Air Pollutes on Vegetation; Resistance and Susceptibility of Different Plant Species in Various Habitats, In Relation to Plant Utilization for Shelter Belts and as Biological Indicators. M. Y. Nuttonson (ed.), vol. 2, Silver Spring, Md., American Institute of Crop Ecology, 1969, p. 6-7. (Also: Akad. Nauk SSSR Ural. Filial. Komis. po Okhrane Prirody. Rastitel' nost' i promyshlennye zagryaznenlya. Okhrana prirody na Urale. V (Sverdlovsk), 1966, p. 37-38.) The industrial centers of the Apsheron Peninsula discharge a great amount of wastes, particularly carbon monoxide, sulfur dioxide, fluorine compounds, hydrocarbon vapors, chlorine, and hydrogen sulfide. In most cases, these compounds adversely affect green plants which function, at times, as protection against gas and smoke. When the air is polluted by irritant gases dark brown burns appear on the leaves. Partly withered and some yellowed leaves are also found. The toxic action of these pollutants also affects the root system. Trees which exhibit gas resistance include elm, maple, pistachio, oleaster, almond, honeysuckle, and others. The establishment and development of green trees are important as a means of combatting air pollution and for the sanitary well-being of the industrial areas. Several recommendations for establishing green plantings in industrial areas are included.

23214

Rohmeder, E., W. Merz, and A. V. Schoenborn

THE BREEDING OF SPRUCE AND PINE SPECIES WHICH ARE RELATIVELY RESISTANT AGAINST INDUSTRIAL WASTE GASES. (Zuchtung von gegen Industrieabgase relativ resistenten Fichten- und Kiefernsorten). Forstwiss. Zentr., vol. 81, 1962. 14 refs. Translated from German. Belov and Associates, Denver, Colo., 19p., July 7, 1970.

Methods for determining the relative sensitivity of various types of coniferous trees to industrial waste gases are discussed, and attempts to breed more resistant strains of trees are described. Phenotypically resistant spruce trees are selected from damaged areas and used to supply grafts for testing purposes. The fact that the resistance is based on heredity is determined by exposing the grafts, along with pure sensitive samples, to varying concentrations of sulfur dioxide gas and hydrogen fluorine gas. No visible damage occurred on the grafts, while the others indicated symptoms. The chemical analysis of needles from resistant trees shows that they have lower sulfur values than more sensitive trees do. The resistant cuttings can be propagated and distributed in areas where more sensitive trees cannot survive.

23222

Griffin, S. W. and B. B. Bayles

SOME EFFECTS OF FLUORINE FUMES ON VEGETATION. In: Air Pollution, U. S. Technical Conference on Air Pollution. Louis C. McCabe (ed.), New York, McGraw-Hill, 1952, Chapt. 10, p. 106-115. 1 ref.

Peach, apple, wild black cherry, Norway spruce, buckwheat, tomato, and corn plants were fumigated with relatively low and moderate concentrations of hydrofluoric acid gas in order to determine concentrations that might cause injury to various species, the appearance and character of injury, and the absorption of fluorine by plants. A wide variety of soil, meteorologic, and plant variables are noted that must be considered in interpreting the data from these tests. The leaves of peach, wild black cherry, buckwheat, tomato, and corn are very susceptible to acute damage when exposed to small amounts of hydrofluoric acid in the air. Apple foliage was less susceptible. Acute leaf injury resulted from fumigation at night as well as in daylight, although the injury was less. Pin-point chocolate-colored lesions produced at the tip ends of peaches

served as the entry point for fungi which caused rotting. Fluorine content of leaves was markedly increased, but even relatively heavy exposures caused little increase in the fluorine content of the fruit. Exposure of peach trees for a few hours to hydrofluoric acid gas concentrations as low as 0.05 to 0.1 ppm may cause acute damage to a small percent of the leaves, but that higher concentrations or longer exposures are required to cause twig or shoot damage. The usefulness of buckwheat and various coniferous species as indicators of fluorine and other toxic gas pollution is discussed, as well as the fluorine content of soils. Lime applied to soils to which fluorine had been added greatly reduced the uptake of fluorine from the soil and prevented plant injury. (Author summary modified)

23295

Antipov, V. G.

THE EFFECT OF INDUSTRIAL SMOKES AND GASES UPON CONIFEROUS FORESTS GROWING UNDER CONDITIONS OF INCREASED HUMIDITY IN THE MOSCOW REGION ('PODMOSKOV'E'). In: American Institute of Crop Ecology Survey of USSR Air Pollution Literature. Vol. III. The Susceptibility or Resistance to Gas and Smoke of Various Arboreal Species Grown Under Diverse Environmental Conditions in a Number of Industrial Regions of the Soviet Union. M. Y. Nuttonson (ed.), Silver Spring, Md., American Institute of Crop Ecology, 1970, p. 39-44. 12 refs. Translated from Russian. (Also: Byull. Gl. Bot. Sada, no. 46:41-46, 1962.)

An investigation of the relationship between industrial pollution and damage to coniferous trees in presented. A definite correlation between the destruction of pines and their distance from industrial enterprises is noted. The accumulation of sulfates, by the assimilating mechanism, is one of the verified symptoms of damage to plants from sulfur dioxide. The effect of humidity upon the concentration of atmospheric pollutants is discussed. The presence of fog increases the concentration of pollutants. Increased humidity is not only conducive to acidic fogs, but also prevents the closing of the stoma, a condition which allows easier penetration of pollutants. The toxicity of sulfur gases is increased if carbon monoxide, nitric oxides, aldehydes, and ozonides are present. Ammonia, hydrogen sulfide, and hydrogen fluoride are other serious contaminants.

23386

Cormis, L. de

ABSORPTION AND ACCUMULATION OF ATMOSPHERIC FLUORINE BY THE LEAVES OF CERTAIN HERBACEOUS PLANTS. (Absorption et accumulation du fluor atmospherique par les feuilles de certains vegetaux herbaces) Ann. Physiol. Veg., 10(4):251-262, 1968. 16 refs. Translated from French. Belov and Associates, Denver, Colo., 24p., June 18, 1970.

The effects of atmospheric fluorine compounds, such as are emitted from aluminum industries, on various leafy plants are investigated. Tomato, bean, and tobacco plants were grown under controlled conditions and subjected to varying hydrogen fluoride concentrations and different atmospheric conditons. The rate of absorption of atmospheric fluorine is clearly proportional to the concentration, time of exposure, and relative humidity. The fluorine is accumulated near the edges of the leaves and results in necroses in that area. The level of toxicity varies from plant to plant. It can be attained from a heavy concentration of short duration, or more probably from a semi-permanent pollution of low concentration. The difference between fluorine and sulfur dioxide absorption is explained.

23516

NEW TECHNIQUE AIDS STUDY OF SMOG EFFECTS ON CITRUS PLANTS. Chem. Eng. News, 39(8):42-43, Feb. 20, 1961.

A technique for removing oxidants from smog without affecting the concentration of fluorides was developed for use in a long-term study of smog damage to citrus trees. The technique is based on the gas-phase reaction between oxidants and nitric oxide, which removes virtually all the ozone though not all the peroxyacyl nitrates. The oxidants are first mixed with filtered room air and fluoride, then with the reductant in a large polyethylene reaction chamber. If desired, hydrogen sulfide can be added to air leaving the chamber to promote further oxidant removal. Effluent from the chamber is divided between a fluoride recorder and an oxidant recorder. The possibility that hydrogen sulfide might protect plant leaves from oxidants is noted.

23576

Bolay, A. and E. Bovay

OBSERVATIONS ON THE SENSITIVITY TO FLUORINATED GASES OF SOME PLANT SPECIES OF VALAIS. (Observations sur la sensibilite aux gaz fluores de quelques especes vegetales du Valais). Phytopathol. Z., vol. 53:290-298, 1965. 11 refs. Translated from French. Belov and Associates, Denver, Colo., 17p., June 18, 1970.

Observations made over a period of 15 years on the relative sensitivity of various plants to fluorine compounds are reported. The three methods used in evaluating damage to plants are: observation of typical necroses appearing on the foliage, chemical analyses of the fluorine content of the plants, and utilization of certain indicator species to detect fluorine. Examinations of tree leaves permit the establishment of sensitivity limits. No injury occurs below 25 ppm, variable reactions occur from 25-105 ppm, depending on the climate and health of the plants, and burns are almost always present from 105 ppm on. Plant species are separated into 4 classes based on their sensitivity. The most sensitive plants can be used as indicators of the presence of fluorine, both in terms of the degree of contamination and the limits of the contaminated zone.

23579

Hluchan, Eugen, Jan Mayer, and Emil Abel

THE INFLUENCE OF ALUMINUM-WORKS EXHALATIONS ON THE CONTENT OF FLUORIDES IN SOIL AND GRASS. Pol'nohospodarstvo, 10(4):257-262, 1964. Translated from Slovak. Belov and Associates, Denver, Colo. 7p., June 26, 1970.

Between 1958 and 1962, fluoride analyses were carried out on 338 soil samples and 72 grass samples from the vicinity of an aluminum plant. Soil from the south side of the plant showed fluoride values as high as 91.0 mg. Values for the remaining area ranged from 4.8 to 53.1 mg, averaging 20 to 29 mg. In contrast, the average fluoride value for soil from an uncontaminated area was 13.6 mg. Grass samples showed fluorides to a value of 118.7 mg in 100 g of dry substance, while the fluorine content of light dust reached a value of 5.0 mg/100 g of fresh grass. The content of fluorine compounds in soil and grass decreased with increasing distance from the plant. The determined values in the proximity of the plant represent a multiple transgression of the natural content of fluoride in soil and grass.

23580

Reinhard, H.

FLUORINE DAMAGE IN THE LOWER FRICK VALLEY. (Die Fluorschaden im unteren Frichtal). Schweiz. Arch. Tierheilk., 101(1):1-4, 1959. (Presented at the Swiss Veterinary Society, General Convention, Brunnen, 1959.) Translated from German. Belov and Associates, Denver, Colo., 5p., July 10, 1970.

Even though the only aluminum produced in Germany today is manufactured by an electrolytic method, fluorine emissions are still 500 kg per day. In the area of one plant, the quantity of fluorine sedimented per acre in 1956 amounted to approximately 7 kg at 300 m from the plant, decreased rapidly to 0.9 kg at 700 m, and then decreased slowly with increasing distance. Severe clinica phenomena have been observed on vegetation at quite distant locations and can be attributed only to airborne fluorine. Moreover, feed plants (hay and grass) have been damaged, even when their fluorine levels were below those considered toxic by most authors.

23624

Hais, K. and J. Masek

EFFECTS OF SOME EXHALATIONS ON AGRICULTURAL ANIMALS. (Ucinky nekterych exhalaci na hospodarska zvirata). Ochrana ovzdusi, 1969:122-125, Aug. 1969. 15 refs. Translated from Czech. Belov and Associates, Denver, Colo., 14p., June 16, 1970.

The effects of various pollutants on farm animals are discussed. The emissions from such sources as power plants, metal processing, cement works, chemical industries, fertilizing, and nuclear installations are described. The effects of the various pollutants can vary, depending upon such factors as concentration, climate, age of animals, health of animals, and individual sensitivity. Inhalation of ashes, cinders, or other light particulates causes irritation and inhibits important digestive processes. Sulfur dioxide irritates mucous membranes and disrupts metabolic processes. The symptoms of acute and chronic arsenic poisoning are discussed. A considerable degree of toxicity for cattle is noticed from power plant ashes. Bees show a marked effect from exposure to arsenic compounds. Typical symptoms of fluorosis in cattle are dental changes. Synergistic effects of pollutants are mentioned. The general air quality of Czechoslovakia is discussed, and current legislation, including air quality standards, is described. An estimation of economic damages due to air pollution is given.

23639

Bredemann, G. and H. Radeloff

FLUORINE ABSORPTION THROUGH THE BARK OF SHOOTS AND ITS EFFECTS. Angew. Botan., vol. 19:172-181, 1937. Translated from German. 10p.

The effects of fluorine absorption on the shoots of plants and trees are investigated. The primary goal of the research is to determine whether the fluorine compounds which penetrate the bark of the shoots in an earlier season can affect the spring growth of the plant and/or effectively disturb the identification of fluorine fume damage on spring growth. Shoots accumulate fluorine-containing waste gases more or less in their barks, as much a result of exposure in winter as in summer. They are also capable of, but seldom do, store up accumulations in the xylum in water soluble and insoluble forms. The blossoming of branches and the further development of new growth are not noticeably injured by the fluorine compounds which are stored in the bark. All new outgrowths of fluorine-containing branches remain free of fluorine in a fume-free atmosphere. Proven fluorine content in spring growth is regularly a proof of a new fluorine fume effect during or after the blossoming.

23661

Garber, Kurt

ON THE ABSORPTION OF HARMFUL SUBSTANCES THROUGH TREE BARK. Wiss. Z Tech. Univ. Dresden, vol. 3, Nov. 14, 1961. 12 refs. Translated from German. 10p.

The absorption of fluorine, fluoride compounds, tar, asphalt vapors and ammonia through the bark of trees and bushes is reported. Absorption of these substances through bark during the dormant winter season was demonstrated in simulated laboratory experiments. Examination of field specimens obtained in the vicinity of a superphosphate plant indicated that the fluoride content of the bark was inversely in agreement with the distance from the source. A similar observation was made of the woody material but to a considerably lesser degree. Exposure of trees and pruned branches to HF vapor resulted in a bark concentration dependent on the exposure time and a wood concentration reflecting the exposure intensity. Applying a 2% solution of sodium fluoride to the branches caused a 50 % increase in the observed fluoride content of the wood portion. Almost all the fluoride vapor exposed trees were damaged as exhibited by delayed spring growth. The leaves of exposed trees contained 2-3 times the fluoride as the control specimens. Examination of dormant branches from the vicinity of tar and asphalt processing facilities clearly indicated the presence of these substances stored in the bark, and, depending on the kind of plant, that more or less of these substances were transferred to the wood. Rough bark appeared to enhance the pick-up of the substances. The transfer of these materials to spring growth was in most cases very slight. Similarly, dormant branches were exposed to ammonia and, while NH3 could be detected in the bark in all cases, it could not be detected in the wood in all cases. The effect of low concentrations for long periods of time was greater than that of high concentrations for short periods of time. High-concentration, short-term exposure of NH3 acted as a fertilizer, causing earlier sprouting and better leaf color. Low-concentration, long-term exposures had a detrimental effect. By late May, the ammonia content of the test specimens was the same as that of the control specimens.

23794

Adams, Donald F.

THE EFFECTS OF AIR POLLUTION ON PLANT LIFE. A.M.A. Arch. Ind. Health, vol. 14:229-245, July-Dec. 1956. 86 refs. (Presented at the American Industrial Hygiene Association, Annual Meeting, 17th, Philadelphia, Pa., April 23-27, 1956.)

Knowledge of the range of foliar expressions of plants exposed to atmospheric pollutants is extremely useful to those engaged in the study of the scope and severity of an air-pollution problem. The wide variations in susceptibility and characteristic response of common species to typical contaminants provide a convenient method for identifying, determining the distribution of, estimating the level of, and providing a collection medium for subsequent chemical analysis for a pollutant. A detailed review of the progress of research on the effects of sulfur dioxide, hydrogen fluoride, and 'Los Angeles-type' smog since 1950 is presented (with work published prior to 1950 cited to provide continuity whenever necessary). Fluoride appears to be a cumulative phytotoxicant which may move through the plant vascular system to the leaf tip or margin and produce foliar necrosis upon accumulatio of a 'threshold con-

centration.' Evidence also points toward possible enzymatic inhibition. Sulfur dioxide and smog exposures result in foliar injury only if the rate of tissue absorption exceeds the rate at which the plant can effectively neutralize the toxic agent. Smog, however, can produce growth inhibition without producing visible injury, whereas sulfur dioxide does not produce this so-called invisible injury. Reference is made to a catalogue of common weeds according to their characteristic foliar response and susceptibility to a number of pollutants. (Author summary)

23852

Bossavy, M. J.

NECROSIS CAUSED BY FLUORINE. (Les necroses due au fluor). Pollut. Atmos. (Paris), 8(30):176-184, June 1966. Translated from French. Belov and Associates, Denver, Colo., 9p., Sept. 4, 1970. (Also: Revue Forestiere, no. 12, Dec. 1965.)

The shape, color and evolution of necrosis due to fluorine are described for a certain number of leaf-bearing coniferous vegetatio according to the stage of development of the leaf. The experiments of Professor Holland, 1908-1909, and his album containing pen sketches and a collection of samples are presented. The only common characteristic to note is that such flaws begin to be seen at the tips of the needles; in the leaves, they will be noticed either at the very tip of the leaves, in long narrow leaves, or els almost simultaneously at the tip and on the edge of the leaf if suc is a wide and whole leaf. If the leaf has serrated edges, the necrosis is evident at the points of tips of the lobes. Often the tainted parts assume a 'V' shape, the point directed towards the leaf stalk, but it quickly moves along the leaf blade and assumes a very different shape. In the cherry and other plants, the tainted parts will be easily detachable, leaving an undulating line where they have been severed. Little patches of yellowish color will often be dispersed along the blade and inside the leaf itself. The color of the damaged parts varies from black to a brown or ruse color. Sometimes all needles of the same age on a given branch wil show necrosis of the same color obviously in the same stage of development. Characteristics are cited for the cherry tree, chestnut, alfalfa, walnut, peach, pear, sainfoin, vine, lime tree, larch, hawthorn, saffron, barberry, gentian, millepertuis, myrtle, lily of the valley, solomon's seal, silene, the common pine, pectin fir, and spruce. Meteorological factors are also mentioned.

23874

Kotte, W.

SMOKE DAMAGE TO STONE FRUIT. (Rauchschaden an Steinobst-Fruchten). Nachrbl. Deut. Pflanzenschutzdienst (Berlin), no. 9:91-92, 1929. Translated from German. Belov and Associates, Denver, Colo., 4p., Sept. 8, 1970.

Of the fruit trees in the neighborhood of a brickyard, the apples and cherries were undamaged, while in contrast the damson plums, yellow plums, and yellow Victoria plums showed damage on foliage and fruit. Damage symptoms of the damsom plums were necrotic spots of tissue that appeared either as sunken patches about fingernail size or, in cases of greater extend, as an apical zone of retarded growth. The diseased tissue was coffee brown in color, and beads of sap frequently could be found around the border of the necrotic zone. Microscopic examinations revealed that the epiderma cells were filled with brown granular masses instead of dark blue anthozyan. The pericarpal tissue, which in a healthy condition exhibits vesicular, almost empty appearing cells with transparent walls, was small-celled, with brown colored cell walls covered with brown granular concretions. Limitation of the damage to the end of the fruit is explained by the fact that here the rain drops hold on longest and the gases dissolved in the water have their strongest influence. The cause of the smoke damage is attributed to hydrofluoric acid.

23950

Bovay, E.

EFFECTS OF SULFUR DIOXIDE AND FLUORINE COMPOUNDS ON VEGETATION. (Effets de l'anhydride sulfureux et des composes fluores sur la vegetation). Station Federale de Recherches de Chimie Agricole, Liebefeld-Bern, Switzerland, Air Pollution Proceedings of the First European Congress, on the Influence of Air Pollution on Plants and Animals, Wageningen, Netherlands, 1968, p. 111-135. 81 refs. Translated from French. Belov and Associates, Denver, Colo., 34p., Aug. 28, 1970.

The sources of sulfur dioxide and fluorine pollutants are described and the damage caused to plants by these compounds are related. Sulfur dioxide penetrates to the interior of plants through the stoma; therefor every condition favoring the opening of the stoma also increases the assimilation of SO2. The caustic action of SO2 is due to its reducing action, which can affect plant metabolism. Sensitivity to SO2 depends on such factors as age, nutritive state, and individual tolerances. Relationships between pollutant concentration and time of exposure are a determining factor in threshold limitations. A distinction between plant injury and damage is made. Various attempts to observe and control atmospheric pollution are described. Fluorine compounds are among the most toxic of pollutants. Fluorine accumulation in soils and plants is discussed. The effects of fluorinc on various types of plants are noted. Synergistic action can occur when certain elements introduced by fertilizers react with fluorine compounds found in the atmosphere. Most plants seem to have a fluorine threshold beyond which photosynthetic processes can be invisibly damaged. Certain plants, due to their highly sensitive nature, can act as indicators of atmospheric pollution. Recent experiments involving the effects of fluorine on fruit trees are described.

23986

Wentzel, K. F.

SENSITIVITY AND DIFFERENCES IN THE RESISTANCE OF PLANTS TO AIR POLLUTION. (Empfindlichkeit und Resistenzunter schiede der Pflanzen gegenuber Luftverunreinigung). In: Air Pollution on Plants and Animals. Wageningen, Netherlands, Center for Agricultural Publishing and Documentation, 1969, 357-370. 27 refs. Translated from German. Belov and Associates, Denver, Colo., 17p., Sept. 28, 1970.

Until 1940, 2 ppm of sulfur dioxide in the air was supposed to be the maximum acceptable concentration for long duration pollution. Recent experiments in the field in various areas have shown that the limit has to be reduced to 0.02 ppm and for HF it must be considerably lower. It is better to characterize air pollution by the frequency and duration of the times a certain critical concentration is exceeded, rather than by average concentration. The resistance of plants varies with the type of emission, conditions of growth, phase of development, and exposure. A distinction must be made between experimental resistance gauged by leaf sensitivity and resistance in the field measured by yield and endurance. A generally valid sequence of potential damage areas for plants cannot be made, but a scheme for their classification into three groups is given. In order of generally increasing sensitivity, plants can be grouped in the following manner: agricultural crops, decidous forests, gardens and fruit plants, fodder crops, and coniferous

forests. This investigation into the sensitivity of plants to air pollution and the differences in their resistance to various types of pollutants has revealed that this can be counted among the most complicated problems of biology. Nevertheless, the illusion is widespread that this matter may be judged casually and simply. Only by recognizing the severity of the problem can progress be made. (Author summary modified)

23988

Yamazoe, Fumio and Teruo Nakamura

ON NUTRITIVE CHANGES OF WATER FIELD RICE PLANT CAUSED BY HYDROGEN FLUORIDE. FUNDAMENTAL RESEARCH CONCERNING SMOKE POLLUTION ON PLANTS. (REPORT 3). Nippon Dojo-Hiryogaku Zasshi (J. Sci. Soil Manure Japan), vol. 31:29-32, 1960. 12 refs. Translated from Japanese. Belov and Associates, Denver, Colo., 11p., Sept. 30, 1970.

In order to investigate nutritive effects of smoke pollution caused by hydrogen fluoride gas on plants, hydroponic cultures of water field rice plants were made and contacted with hydrogen fluoride at 500 ppm concentration for 1 hour. The samples were then picked out at the times of minimum and maximum assimilation of carbon after two days, and the yields of every section of the plant as well as various components were measured. Their changes were checked by comparison with those in the control lots. Chlorophyll contents in the rice plants above the ground in the contact lots decreased immensely, accompanied with a decline of increase of carbohydrate at the time when the afternoon assimilation function reaches its highest. This shows clearly that the carbon assimilation deteriorates. Among carbohydrates, the decrease of production of non-reducing sugar was especially noteworthy. Nitrogen in the contact lots, as compared with that in the control lots, showed a decline in pure protein ratio, and demonstrated a tendency toward a large ratio of amide-ammonia- nitrogen which was not completely assimilated to the plants. Among inorganic components, the absorption of potash declined considerably after gas contact, and magnesia tended to stay in the roots. Lime, however, showed scarcely any damage. Silicic acid tended to show an increasing absorption. The sections in the plants where fluorine is contained are the leaf blade, sheath, and root, in that order. Most fluorine exists in the leaf blades. The fluorine doesn't seem to move around in the system after gas absorption; neither does it purge from the roots. For the prevention of such injurious components and to promote recovery from abnormal metabolism, lime, magnesia, silicic acid, and so forth, should be valuable. (Author summary modified)

24024

Radeloff, H.

INVESTIGATION AND APPRAISAL OF FLU-GAS DAMAGE. (Untersuchung und Begutachtung von Rauchschaden). Hamburg Staatsinst. Angew. Botanik Jahresber., vol. 6:126-127, 1939. 1 ref. Translated from German. Belov and Associates, Denver, Colo., 4p., June 12, 1970.

Waste gases containing fluorine and sulfurous acid are reported to damage plants and bees. Branches of fruit trees afflicted by fluorine had leaves which showed numerous spots, intercostal discolored stripes, or also withered tips and periphrasis. All which remained, in some cases, were the blackish brown withered remains of the leaves. At a location in central Germany, the bees of a migrating stand died without any immediately apparent reason. However, they had their hives in the vicinity of a plant working with fluorine, and the mass dying started quite suddenly with the same day on which the wind had changed in their direction. An investigation for sulfurous acid in 36 plant samples resulted in various causes, from manufacturing plant flue gases to gas remnants coming from a habitation treated with sulfur.

24035

Baldacci, Elio and Vincenzo Ceccarelli

AIR POLLUTION AND PLANT LIFE. World Health Organization, Copenhagen (Denmark), Regional Office for Europe, Proc. Conf. Public Health Aspects Air Pollution Europe, Milan, Italy, 1957, p. 76-95. (Nov. 6-14.)

The use of plants as indicators of air pollution is duscussed in detail. Five requirements are reviewed as necessary for a scientifically rigorous study of symptomatology: (1) on-site inspection of injury; (2) exclusion of other causes; (3) comparativ examination of injured and uninjured species in the area; (4) comparative examination of species and varieties injured in the area; and (5) topographic and climatologic investigations. In summarizing many years of experience in studying plant injuries from atmospheric pollutants, two tables are presented giving the relative susceptibility of a large variety of plants to sulfur di- and trioxide, chlorine, fluorine, and ammonia, with particular relevance to conditions prevalent in various parts of Italy. It is noted that plant injury cannot be judged solely on the basis of chemical analysis; neither is plant inspection always sufficient, since there are no leaf injuries, however typical, that cannot also be produced by causes having nothing to do with air pollution. It is concluded that the use of plants as indicators of air pollution is possible and advisable if precise and exact rules for their use are followed, and that estimation of damage is made by a fully-qualified and experienced phytophathologist in order to avoid the many gross errors which can otherwise be easily made.

24036

Houten, J. G. Ten and F. Spierings

AIR POLLUTION AND ITS INFLUENCE ON VEGETATION. World Health Organization, Copenhagen (Denmark), Regional Office for Europe, Proc. Conf. Public Health Aspects Air Pollution Europe, Milan, Italy, 1957, p. 70-75. (Nov. 6-14.)

Investigations on the effects of hydrogen fluoride and sulfur dioxide on plants are reported. Fumigation chamber experiments established that the gladiolus variety 'Sneeuwprinses' is extremely susceptible to HF, whereas alfalfa appears to be a useful SO2 indicator. Gladiolus leaf analysis indicated a connection between the intensity of damage and fluorine content, and between these factors in relation to distance from the emitting source. Because of the high sulfur content of alfalfa leaves outside industrial areas, leaf analysis is a useful method for detecting SO2 damage primarily in cases of severe plant injury. Air quality measurements were made in different areas to establish any correlations with chemical leaf analysis. As a result of 110 measurements with SO meters in an area containing SO2 pollution, a daily average of 3-4 mg SO2 was calculated as about the danger limit for plant damage. A monthly total amount of 30-60 ppm fluorine taken up by lime soaked filter paper was the limit at which damage was found on the susceptible gladiolus variety planted next to the measuring point. At 60-120 ppm, slight damage was found on less susceptible crops. Severe smoke damage to fruit trees due to HF was established, the adjacent HF apparatus absorbing as much as a monthly total amount of 304 ppm.

24064

Rohmeder, E. and A. von Schonborn

THE INFLUENCE OF ENVIRONMENT AND HEREDITY ON THE RESISTANCE OF FOREST TREES TO THE ATMOSPHERIC IMPURITIES ORIGINATING FROM INDUSTRIAL WASTE GASES. A CONTRIBUTION FOR THE BREEDING OF A RELATIVELY FLUE GAS RESISTANT SPECIES OF SPRUCE TREES. Forstwiss. Zentr., vol. 84:1-3, 1965. 9 refs. Translated from German. 20p.

Experiments to determine to what extent the resistance to flue gas can be determined by environmental factors and heredity are described. In addition, the limits of gas concentrations within which young trees can survive and thrive are determined. The environmental factors studied include nutrition, water supply, relative humidity, and others. Varying concentrations of sulfur dioxide and hydrogen fluoride are administered under controlled conditions to determine resistance. Damage increases with increasing humidity and light intensity. An optimum supply of nutrients increases resistance. For SO2, the first damage symptoms occurred after a ten day exposure to 0.5 mg/cu m; at 2.0 mg/cu m all assimilation organs are destroyed. For HF, the first damage symptoms occurred at 0.025 mg/cu m; total damage occurred at 0.25 mg/cu m. The resistance of oak and poplar is much greater than spruce, larch, or fir. Also, the grafts of the resistant strains are more resistant, indicating heredity as a cause of resistance.

24282

MacIntire, W. H. et. al.

EFFECTS OF FLUORINE IN TENNESSEE SOILS AND CROPS. Ind. Eng. Chem., 41(22):2466-2475, Nov. 1949. 78 refs.

Findings are reported from 20 years of experimentation upon the fate of soil incorporations of various fluoric materials such as insecticides, fertilizers, sodium, potassium, and magnesium fluorides, slags, rock phosphate, and cryolite through determinations of induced chemical and bio-chemical phenomena, retention of fluorine against lysimeter leachings of rain waters, and fluorine content of roots and top growth in greenhouse cultures. The early lysimeter experiments and greenhouse studies as to uptake of fluorides were extended to ascertain fluorine occurrences in the atmosphere, in rain waters, in soils, and in vegetation on farms in locales where injurious effects upon plant and animal life were purported to have been caused by atmospheric effluents from the increased manufacture of aluminum in Blount County in east Tennessee and from expanded operations in the processing of rock phosphate in Maury County in middle Tennessee. Soils possessed remarkable retention of the fluorine carried by insecticides, fertilizers, and various fluoric compounds, while yielding abnormal concentrations of fluorides to the rain water leachings from incorporations of electric furnace slag. Vegetation effected virtually no enhancement in the uptake of fluorine from soils that possessed adequacy of calcium, either naturally contained or added. Comparative analyses of crops grown on soils, in place and after transportation to unaffected points, served to support the conclusion that abnormal incidence of fluorine in field vegetation is attributable to atmospheric contaminants. (Author abstract modified)

24330

Oelschlaeger, W., W. Woehlbier, and K. H. Menke

THE FLUORINE CONTENTS OF VEGETABLE, ANIMAL, AND OTHER MATERIALS FROM AREAS WITH OR WITHOUT EMISSIONS OF FLUORINE. COMMUNICATION I. THE FLUORINE CONTENTS IN VEGETABLE, ANIMAL, AND INORGANIC MATERIALS FROM AREAS WITHOUT EMISSIONS OF FLUORINE. (Ueber Fluor-Gehalte pflanzlicher, tierischer und anderer Stoffe aus Gebieten ohne und mit Fluoremissionen. I. Mitteilung. Fluor-Gehalte pflanzlicher, tierischer und anorganischer Stoffe aus Gebieten ohne Fluoremissionen). Text in German. Landwirtsch. Forsch., vol. 20: 199-209, 1967. 11 refs.

For investigations regarding the effects of fluorine on plants and animals, it is important to know what the normal level of fluorine is in plants, animals, and certain inorganic substances. In other words, what would the fluorine content be if the substance was in an area without the effects of industrial fluorine contamination. The fluorine content of samples of leaves from fruit trees, forest trees, shrubs, bushes, and vegetables and of needles from coniferous trees and farm-grown feeds is determined. The fluorine content in a number of commercial samples of leguminous seeds, oil seeds and oil seed residues, side products of the fermentation industry and of starch and sugar mills, and mineral feed supplements is also determined. The investigations prove that considerable amounts of fluorine are concentrated in some commercial feeds by industrial processing. (Author abstract modified)

24358

Brandt, C. Stafford

SPECIAL JUBILEE SYMPOSIUM: AIR POLLUTION WITH RELATION TO AGRONOMI CROPS. Agron. J., vol. 56:544, 1958. (Presented at the American Society of Agronomy, 50th Anniversary Meeting, Atlanta, Ga., Nov. 20, 1957.)

That agriculture may be adversely affected by local air pollution i generally recognized and accepted. M. D. Thomas has presented a paper at the special jubilee symposium on what has been done, while the other six papers indicate the spectrum of work being done Two papers present different approaches to the potentialities and problems of using vegetation as an index of air pollution and indicator of pollutant dispersion. The problem of 'hidden injury' is supported in the case of smog on citrus and denied in the case of fluorides on tomatoes. Fluoride uptake from soils and its relation to air pollution with fluorides is discussed. In another paper, a new disease of grapes is described and attributed to air pollution.

24362

MacIntire, W. H., Mary A. Hardison, and Della R. McKenzie

SPANISH MOSS AND FILTER PAPER EXPOSURES FOR DETECTION OF AIR-BORNE FLUORIDES. J. Agr. Food Chem., 4(7):613-620, July 1956. 12 refs.

The washdown of fluorides and their fixation by Spanish moss can indicate atmospheric emissions which are responsible for the abnormal incidence of fluorine in nearby field crops. Intensities of fluorine emissions to the atmosphere in certain eastern and central Tennessee locales were determined by month-long covered field-exposures of Spanish moss in cotton (cord), nylon, and dacron bags and of 12.5-cm limed filter papers. Fixations in covered cord and nylon bags were similar to and greater than fixations in the less porous dacron bags, and were greater in the outer zones than in the cores of the moss. Drying the moss decreased its capacity to fix air-borne fluorides. Fixations by the moss in the protected cord and nylon bags and by protected lime filter papers were consistently concordant in spotting high and low occurrences of fluorine in the atmosphere. (Author abstract modified)

24366

Commonwealth Bureau of Soils, Harpenden, England

BIBLIOGRAPHY ON ATMOSPHERIC POLLUTION OF PLANTS AND SOIL (1964- 1949). Rept. 981, 16p., 1965 (?). 86 refs.

An annotated bibliography of articles dealing with the effects of atmospheric pollution on plants and soils is presented. The contaminants covered include sulfur dioxide, fluorine, fly ash, smog, fertilizers, and others. Various types of vegetable plants are discussed, as well as trees and crops. The effects of air pollution are considered in terms of plant damage, plant growth, metabolic processes, and threshold levels. The articles included were published between 1949 and 1964.

24395

Bolay, A., E. Bovay, C. Nuery, and R. Zuber

RELATIONSHIP BETWEEN FERTILIZATION AND THE BURNING EFFECT OF FACTOR EMISSIONS CONTAINING FLUORIDES. (Interaction entre la fumure et la causticite des immissions fluorees). Air Pollution Proc. First European Congr., Influence of Air Pollution on Plants and Animals, Wageningen, The Netherlands, 1968, p. 143-160. 13 refs. Translate from French. Belov and Associates, Denver, Colo., 26p., Sept. 11, 1970.

Studies made of the vineyards and apricot orchards in the central part of the Valais district of Switzerland, an area exposed to atmospheric pollution from aluminum foundries and fertilizer plants show that the causticity of emitted fluorides and the fluorine content of the leaves depend closely on the kind of mineral fertilizer used on the plants. Just how this interaction works is still not known but three possible hypotheses are possible to explain the interrelationship: presence of chlorides, presence of boron and, finally, an unidentified substance, particular to certai phospho-potassium fertilizers. The effect of the fluoride pollutio is made significantly worse by the almost linear diffusion created by the winds of this alpine valley.

24402

Adams, D. F., J. W. Hendrix, and H. G. Applegate

RELATIONSHIP AMONG EXPOSURE PERIODS, FOLIAR BURN, AND FLUORINE CONTENT OF PLANTS EXPOSED TO HYDROGEN FLUORIDE. Agr. Food Chem., 5(2):108-116, Feb. 1957. 32 refs. (Presented at the American Chemical Society, 126th Meeting, Air Pollution Symposium, New York, Sept. 1954.)

Observations of a pathological condition attributed to fluorides in a wide range of plant species resulted in initiation of controlled fumigation experiments to determine the effects of environmental variables upon the rate of foliar response to hydrogen fluoride. Forty plant variaties were exposed to atmospheric concentrations of 1.5, 5, and 10 ppb of HF in daylight and darkness. A consideration of the exposure factors, the product of the hours exposed and the fumigation concentration in ppb of HF, indicates that plants exposed in darkness were on the average 91.3% as responsive to fluoride in the production of visible foliar injury in the darkness as in the daylight. Plants exhibited greater response to fluoride when fumigated daily for 8 hours at 1.5 ppb HF than when fumigated either 8 hours every third day at 5 ppb HF or 4 hours every third day at 10 ppb HF. Correlation coefficients of exposure factor versus foliar fluoride content were generally found to increase in significance as the plant classifications were narrowed from family to genus to species. (Author abstract modified)

24533

Buck, M.

EXPERIMENTS ON THE EFFECT OF AIR POLLUTION ON PLANTS. (Untersuchuchungen ueber die Wirkung von Luftverunreinigungen auf Pflanzen). Air Pollution Proc. First European Congr. Influence Air Pollution Plants Animals, Wageningen, Netherlands, 1968, p. 53-73. 17 refs. Translated from German. Belov and Associates, Denver, Colo., 28p., Sept. 15, 1970.

The use of indicator plants for detecting air pollutants and their range of distribution is gaining ground as a supplement to physical and chemical analyses of air. Plant reactions considered to constitute proof of pollution include the amount of pollutant accumulated and visible symptoms such as necrosis or the presence of certain kinds of lichen. It also seems likely that products produced by metabolic responses of a plant to absorbed pollutants are useful indicators. Combining these indicators with the specific sensitivity of individual plants or species could lead to manifold possibilities. Trials in progress involve the use of indicator chambers, which have an advantage over field indicators in that no damaging substances are absorbed through soil. Using combinations of indicator plants should permit identification of pollutants responsible for damage, even when several pollutants are simultaneously present, as in most industrial areas. A list is included of indicator plants suitable for sulfur dioxide, hydrogen fluoride, gaseous and stable inorganic fluoride compounds, and ozone.

24548

Hansen, E. Don, H. H. Wiebe, and Wynne Thorne

AIR POLLUTION WITH RELATION TO AGRONOMIC CROPS: VII. FLUORIDES UPTAKE FROM SOILS. Agron. J., vol. 50:565-568, 1958. 10 refs.

Five soils, varying in such characteristics as pH, lime, clay, organic matter, and soluble salts, were treated with sodium fluoride at the rate of 0, 200, 400, 800, and 1600 ppm of fluorine. Turnips and alfalfa were grown, harvested, and analyzed for fluorin Similar experiments were conducted using treatments with sodium fluorosilicate instead of sodium fluoride. Plant yields were generally reduced when the fluoride content of the tissues exceeded 60 ppm on a dry weight basis. Reduction of fluoride uptake was associated with increased content of lime, clay, and organic matter in the soils studied. In general, the fluoride was absorbed less readily from sodium fluorosilicate than from sodium fluoride, and reductions in yield were also less with the fluorosilicate. Fluorine uptake from soils which were exposed to several years of airborne fluorine contamination was not appreciably higher than fluorine uptake from several soils taken from an area of little or no contamination. (Author summary modified)

24566

Adams, Donald F., C. Gardner Shaw, Richard M. Gnagy, Robert K. Koppe, Delbert J. Mayhew, and William D. Yerkes, Jr.

RELATIONSHIP OF ATMOSPHERIC FLUORIDE LEVELS AND INJURY INDEXES ON GLADIOLUS AND PONDEROSA PINE. Agr. Food Chem., 4(1):64-66, Jan. 1956. 8 refs.

Injury indexes for two species, Ponderosa pine and gladiolus, exposed to the atmosphere at three locations within an area of fluoride pollution have been related to the average atmospheric fluoride levels for the period July 17 to Aug 2, 1951. The relationship between the atmospheric fluoride levels and the observed injury is shown to be approximately linear in nature at the atmospheric fluoride levels existing at the test sites.

Correlation coefficients showing the relationship between injury indexes and average atmospheric fluoride levels indicate an excellent degree of association between the two variables. The gladiolus showed a greater foliar response to atmospheric fluorides at the lower exposure levels than did the Pinderosa pine. However, the Ponderosa pine exhibited a greater degree of foliar burn, as expressed by the injury indexes, at the higher exposure levels than did the gladiolus. (Author summary)

24787

Navara, J.

SOME DATA ON THE WATER BALANCE IN PLANTS IN THE PRESENCE OF FLUOR IN THE SUBSTRATE. (Beitrag zur Kenntnis der Wasserhaushalt der Pflanzen bei Anwesenheit des Fluors im Substrat). Air Pollution Proc. First European Congr. Influence Air Pollution Plants Animals, Wageningen, Netherlands, 1968, p. 91-97. Translated from German. Belov and Associates, Denver, Colo., 7p., Oct. 28, 1970.

Studies were conducted of the water balance of the Senator variety of Pisum sativum in the presence of fluor (in the form of sodium fluoride) in the substrate. The effect of fluor was seen in a withering of those portions of the plant above the soil. The unfavorable hydration condition observed is the result of changes in the amount of water assimilated and the amount given off. The presence of fluor first stimulated and then reduced the amount of water given off. No preliminary increase was noted before the amount of water taken in was reduced, and plants assimilated no water after 68 hrs in the presence of 0.29 and 0.25 g/l F. A balance between the amount of water taken in and given off was reached only after approximately 27 hrs at a level of approximately 40% of the original transpiration and approximately 90% of the original water content of the plant.

24852

Cormis, L. De

COMPARISON OF THE EFFECTS OF SULPHUR DIOXIDE AND OF THE DERIVATIVES OF FLUORINE ON A FEW PLANTS. (Action Compare de l'anhydride sulfureux et des derives fluores sur quelques vegetaux). Proc. Intern. Clean Air Cong., London, 1966 (Part I), 6(5):171-173. Translated from French. Belov and Associates, Denver, Colo., 9p., Sept. 9, 1970.

The frequent absence of a correlation between plant damage and air pollution in the vicinity of a plant emitting 400 tons per day sulfur dioxide and 150 kg per day fluorine led to studied of the nature of the absorption of both pollutants in plants. Both fluorine and sulfur dioxide are absorbed by leaves of tomato plants in proportion to the amount applied. However, absorbed sulfur migrates within the plants and is distributed as the sulfur normally found in plants. Fluorine is accumulated by the leaves, resulting in eventual necrosis beyond a certain limit; these limits have to be separately defined for each species of vegetation. Because sulfur is metabolized in part by the plant, it cannot have a cumulative toxic effect when applied in subtoxic quantities.

24933

Bossavy, J.

INFORMATION ON DAMAGE CAUSED BY AIR POLLUTION TO THE PLANTS AND ANIMALS IN EUROPEAN COUNTRIES. (Informations sur les dommages causes par la pollution de l'air aux plantes et aux animaux dans les pays europeens). Air Pollution Proc. 1st European Congr. on the Influence of Air Pollution on Plants and Animals, Wageningen, The Netherlands, 1968, p. 15-26. Translated from French. Belov and Associates, Denver, Colo., Sept. 3, 1970.

All specialists agree that sulfur dioxide and fluorine compounds are particularly important plant toxins. Picea abies, Abies alba, and Pinus sylvestris, by far the most important trees cultivated in Central Europe, are highly susceptible to these two pollutants. The damage caused by them reaches alarming proportions, endangering the existence of forests in many areas. The total area of damaged forests probably approaches 400,000 hectares. Damages to land under cultivation are less spectacular because growing conditions can be artificially improved. Pollution effects are often limited to the yield or partial loss of quality for one growing season. The influence of fluorine on animal teeth and bones is well known: the effects can be partly averted by adding correct amounts of phosphate and calcium to animal rations or by supplying feed containing sufficient minerals. In general, research on the effect of pollutants on vegetation is directed toward the absorption of pollutants, their transport in leaf parenchyms, and their effects on physiological processes. Creation of new species or varieties of domestic plants capable of supporting high pollution levels seems possible. (Author abstract modified)

24944

Shupe, James L.

LEVELS OF TOXICITY TO ANIMALS PROVIDE SOUND BASIS FOR FLUORIDE STANDARDS. Environ. Sci. Technol., 3(8):721-726, Aug. 1969. 4 refs.

Results of controlled fluorosis experiments and clinical experience with more than 77,000 animals in enzootic fluorosis areas confirmed that factors which govern the reactive processes of animals ingesting fluorides include the level or amount of fluoride ingested, duration of ingestion, the type and solubility of fluoride ingested, age of animal at time of ingestion, level of nutrition, stress factors, and individual biological response. Normally, birds are more resistant than mammals to the toxic effects of fluoride ingestion, and rodents tend to be more resistant than larger animals on a body weight basis. Signs and symptoms of acute and chronic fluorine toxicosis are described. Both enamel and dentine are affected by elevated levels of fluoride ingestion during the formative stages of the tooth. The degree of dental fluorosis can be correlated with the amount of fluoride in the bones, degree of osteofluorosis, duration of exposure, age of animal during fluoride ingestion, amount of fluoride ingested during tooth formation, and other reactive processes of the body. Effects of fluoride on bones are discussed; the most consistent measurement of fluorosis is the amount of fluoride retained in the normal mineralizing matrices of the body. It appears that three mechanisms are involved in abnormal bone formation: impairment of the mechanical properties of normally formed bones by excessive fluoridation; precocious remodeling and excessive proliferation; and direct inhibition of normal osteoblastic activity by excessive blood and tissue fluid levels of fluoride. For dairy cattle that received 93 or 49 ppm of fluoride for 7-1/2 years, observations are included for the hair and skin, hoofs, soft tissues, blood, placental transfer, reproduction, and milk production. Aluminum sulfate, aluminum chloride, calcium aluminate, calcium carbonate, and defluorinated phosphate have reduced the toxicity of fluoride in animals.

25099

Knabe, Wilhelm

NATURAL DECREASE OF PINE NEEDLE FLUORINE FROM ATOMSPHERIC IMMISSIONS. (Natuerliche Abnahme des aus Immissionen aufgenommenen Fluors in Fichtennadeln).

Text in German. Staub-Reinhaltung Luft, 30(9):384-385, Sept. 1970. 15 refs.

Analyses of fluorine content of atmospheric origin in pine needles performed immediately following exposure and after a 5 months recovery period during which the pine stands were not exposed to fluorine emission disclosed a natural decrease of the fluorine content to only 10 to 17% of the original accumulation. The causes may be leaching out through precipitation, evaporation of volatile fluorine compounds from the needles, transport into other parts of the tree and loss of fluorine to the soil through roots. Experiments with tomatoes and beans speak for the first assumption as the principal cause of the fluorine decrease. The filtering capacity of pine stands for fluorine is greater than was assumed because the results of fluorine analysis represent only part of the absorbed F. It follows that plant fluorine analyses must not be evaluated statically but that they must be interpreted in the context of the dynamics of fluorine intake and outgo.

25230

McCune, D. C. and A. E. Hitchcock

FLUORIDE IN FORAGE: FACTORS DETERMINING ITS ACCUMULATION FROM THE ATMOSPHERE AND CONCENTRATION IN THE PLANT. Preprint, International Union of Air Pollution Prevention Associations, 17p., 1970. 15 refs. (Presented at the International Clean Air Congress, 2nd, Washington, D. C., Dec. 6-11, 1970, Paper MB-40B.)

The results of a series of experiments on field plots were analyzed to determine the relationship of the concentration of hydrogen fluoride and duration of the exposure period to the accumulation of fluoride in alfalfa (Medicago sativa L.) and orchard grass (Dactylis glomerata L.). Replicate groups of plots containing alfalfa and orchard grass were exposed to HF at mean concentrations of 0.5 to 7 microgram F per cu m for 3-, 6-, or 9-day periods. Additional groups of plots containing alfalfa alone were exposed to the same range of HF concentrations for 7 days to give a total of 270 separate fumigations over a period of 4 years. The mean concentration of fluoride in forage that was not exposed to HF was 5.3 ppm (microgram F per gram dry weight) in alfalfa and 4.4 ppm in orchard grass with standard deviations of 2.0 and 1.9 ppm F, respectively. Overall regression of fluoride concentration in ppm (F) on mean concentration of HF in microgram F per cu m (C) for duration of exposure in days (T) gave the equation F equal to 1.13CT - 1.17 for orchard grass and F equal to 1.89CT plus 0.74 for alfalfa with plants exposed to HF for 3, 6, and 9 days. Some variation in the concentration of fluoride in forage could also be accounted for by a loss due to weathering or dilution by growth after fumigation. Although the regressions were highly significant standard deviations from regression of 13.8 and 16.8 ppm for orchard grass and alfalfa, respectively, gave relatively broad confidence limits for the predicted fluoride concentration of a single sample of forage at a given concentration of HF and duration of exposure. Thus, the monitoring of forage rather than the monitoring of air affords better protection agains fluoride-induced damage to livestock. (Author abstract)

25273

MacLean, David C. and Robert E. Schneider

FLUORIDE PHYTOTOXICITY: ITS ALTERATION BY TEMPERATURE. Preprint, International Union of Air Pollution Prevention Associations, 14p., 1970. 23 refs. (Presented at the International Clean Air Congress, 2nd, Washington, D. C., Dec. 6-11, 1970, Paper MB-40C.)

Experiments concerning the effects of gaseous fluorides on vegetation are presented. Gladiolus and sunflower plants were placed in controlled environment fumigation chambers at 16, 21, or 26 C and at relative humidities selected to give the same vapor pressure difference between the intercellular spaces of the mesophyll (100% RH assumed) and the surrounding atmosphere at each temperature. All plants were exposed to hydrogen fluoride (ca. 4.7 microgram F/cu m) continuously for 104 hr followed by a one-week period under the same environmental conditions to allow for symptom development. Symptoms were not apparent in sunflower foliage at any temperature regime. Foliar accumulation of fluorine, as both amount (microgram F/cu m plant) and concentration (ppm F), was about the same at 16 and 21 and increased significantly at 26 C. The severity of necrosis on gladiolus leaf blades was affected by both temperature and the age of the leaf. The older leaves were most resistant and the younger leaves were usually most susceptible. Necrosis was significantly greater at 21 or 26 than at 16 C. Whereas injury generally increased as temperature increased, F accumulation by gladiolus decreased, suggesting that the threshold level for injury is effectively reduced at higher temperatures. (Author abstract modified)

25366

Kuehnert, M.

INDUSTRIAL EMISSION--A POTENTIAL DANGER TO KEEPING AND QUALITY OF FARMING ANIMALS. (Industrielle Emissionen, eine potentielle Gefahr fuer die Haltung und Leistungssteigerung landwirtschaftliche Nutztiere). Text in German. Monatsh. Veterinaermed., 22(16): 526-528, 1968. 2 refs.

In industrialized nations where agriculture is highly developed, more emphasis should be placed on the pathogenesis of chronic diseases in livestock. Particular attention should be paid to particles emitted by foundries, metal-processing plants, and the building materials industry. Examples of particles from these sources are lead, copper, zinc, manganese, arsenic, fluoride, and sulfurous compounds. Severe effects can also be attributed to compounds such as phenols and cyanides present in sewage from chemical industries. Legal provisions governing these emissions are essential in securing the health of animals and humans. (Autho abstract modified)

25499

Linzon, Samuel N.

FLUORIDE EFFECTS ON VEGETATION IN ONTARIO. Preprint, International Union of Air Pollution Prevention Associations, 56p., 1970. 14 refs. (Presented at the International Clean Air Congress, 2nd, Washington, D. C., Dec. 6-11, 1970, Paper MB-40A.)

Vegetation studies were carried out during the growing season of 1969 in the vicinity of fluoride-emitting industries in four areas of Ontario, manufacturing aluminum, fiberglas, diammonium phosphate fertilizers, and superphosphate fertilizers, and located in or adjacent to urban, rural, or agricultural communities. Snow Princess variety gladiolus indicator plots were examined monthly for growth and per cent leaf tip-burn. At the end of the growing season the leaves were chemically analyzed for fluoride and chloride, and for boron at the fiberglas plant. The severity of fluoride-injury found on vegetation at the sample stations in each area was related to the average concentrations of fluoride for the growing season found in the air and in the sampled foliage. High concentrations of fluoride were found in the atmosphere and in vegetation at the stations closest to three major sources of fluorides. Typical symptoms of fluoride-injury were observed on certain plant species. Atmospheric fluorides rarely injure flowers or

fruit on plants. However, near the fiberglas plant, severe fluoride-injury was observed on the wings and seed casings of the key fruit of silver maple trees. The Snow Princess gladiolus plant exhibited severe leaf tipburn and relatively high concentrations of fluoride within their leaves at the plots located closests to the three major sources of atmospheric fluorides. At these plots the corms were reduced in weight and size. Where both fluoride and boron were affecting gladiolus plants the symptoms of leaf injury were similar to those caused by fluorides alone, with the addition of necrotic lesions occurring below and confluent with the fluoride-induced tipburn. The uptake of chloride from the soil by the gladiolus plants were found to be drastically inhibited on the plots located closest to the major sources of fluoride where the gladiolus leaves had absorbed excessive amounts of fluoride from the air. Abatement measures undertaken by the superphosphate fertilizer plant prior to and during 1969 resulted in an average of 66 microgram f/sq cm being recorded at 16 air samplingg stations during the growing season of 1969. This represented a drastic reduction from an average of 516 microgram f/sq cm which was recorded at the same 16 stations in 1965. Vegetation injury was slight and restricted to within one mile northeast and east of this fertilizer plant in 1969. Chloride uptake by the gladiolus plants was not inhibited in any of the indicator plots in this area. (Author abstract modified)

25618

Hart, Gary E.

CYTOGENIC EFFECTS OF FLUORIDE: TECHNICAL PROGRESS REPORT. Texas Agricultural and Mechanical Univ., College Station, Research Grant AP 00447, 6p., 1969 (?). 13 refs.

Chromosomal, mieotic, and mitotic abberations observed in plant roots, leaves, and seedlings exposed to sodium fluoride and hydrogen fluoride are reported. Treatment with HF suggested that the compound is a mutagenic agent that probably blocks replication of DNA. The different types of mitotic abberations caused by sodium fluoride treatment were cured by recovery treatment with 0.002 sodium pyrophosphate. This suggests that fluoride may form an inactive fluoropyrophosphate complex, the activities of which could be expected to inhibit mitotic rates as a result of DNA depolymerization. The addition of glycine to NaF caused a very marked reduction in the frequency of NaF-induced abberations. Plant growth was also inhibited by dimethyl-sulfoxide, ethyl- methane-sulfonate, and colchicine.

25661

Rippel, A. and J. Janovicova

THE INFLUENCE OF FLUORINE EXHALATION ON THE FLORA IN THE SURROUNDINGS OF AN ALUMINUM PLANT. (Der Einfluss von Fluorexhalaten auf die Pflanzenwelt in der Umgebung eines Aluminumwerkes. Air Pollution Proc., First European Congr. Influence Air Pollution Plants Animals, Wageningen, 1968, p. 173- 178. Translated from German. Belov and Associates, Denver, Colo., 5p., Nov. 3, 1970.

Examinations of the forest vegetation and agricultural life in the surroundings of an aluminum plant over a period of six years revealed intoxication and injuries to the vegetation by fluorine compounds. The degree of injury differed in correlation with the distance from the plant and the prevailing wind direction. Further studies revealed that plums were a more sensitive indicator to fluorine pollution than apples, pears, cherries, and grapes. Among vegetables the most striking differences were noted with leaf vegetables such as lettuce and cabbage. Wheat showed higher fluorine contents than rye. (Author summary modified)

25665

Balazova, G. and E. Hlochan

THE EFFECT OF FLUORINE EXHALATION ON ANIMALS IN THE SURROUNDINGS OF AN ALUMINUM PLANT. (Der Einfluss von Fluorexhalaten auf die Tiere in der Umgebung einer Aluminiumfabrik). Air Pollution Proc., First European Congr. Influence Air Pollution Plants Animals, Wageningen, 1968, p. 275-279. Translated from German. Belov and Associates, Denver, Colo., 5p., Nov. 3, 1970.

In the vicinity of an aluminum plant, the presence of fluor was examined in the air as well as in the organs of house sparrows and pigeons. The fluor in milk and eggs produced in the immediate vicinity was simultaneously determined. To a various extent and in the majority of samples, a significant increase of fluor contents was observed. The first evidence of damaging results was fluorosis in the cattle. (Author summary modified)

25735

Shupe, James L., Lorin E. Harris, Delbert A. Greenwood, John E. Butcher, and Harold M. Nielsen

THE EFFECT OF FLUORINE ON DAIRY CATTLE. V. FLUORINE IN THE URINE AS AN ESTIMATOR OF FLUORINE INTAKE. Am. J. Vet. Res., 24(99):300-306, March 1963. 10 refs.

An investigation to determine if the amount of fluorine in the urine could be used as an indicator of the amount of fluorine ingested in the dry matter is described. Thirty-two Holstein-Friesian cows were fed four levels of fluorine, two levels of calcium-phosphorus mineral, and two levels of concentrate mix from about 3 months to 7.5 years of age. Two digestion and balance trials were conducted before calving and three after the animals started to lactate. In addition, after the cows were on trial for 7 years and 52 days, urine was collected approximately every 1.5 hours and composited for each 3-hour interval over a 24-hour period. Urine samples should be taken in the morning for best results; when possible, samples of urine should be obtained from several cows and the results pooled to give a reliable index of the fluorine consumed. The determination of the fluorine- creatinine ratio has merit as a means of adjusting for differences in urine volumes. A correlation exists among concentration of fluorine in the urine, amount of fluorine in dry matter consumed, and length of time that fluorine is ingested. By determining parts per million of fluorine in the urine and combining this with a knowledge of the length of time the animals had ingested fluorine, the ppm of fluorine in the ingested dry matter could be estimated. Taken alone, however, this measurement was an adequate criterion for a definite diagnosis of fluorosis in cattle. (Author summary modified)

25750

DAMAGE CAUSED DUE TO FOUNDRY SMOKE. Allg. Forst Jagdz., no. 67:220, June 12, 1891. Translated from German. Belov and Associates, Denver, Colo., 12p., Oct. 30, 1970.

A strong red discoloration of pine trees and damage to other trees were observed in the vicinity of a factory located by the Rhine River which processes phosphorites. The Belgian phosphorites used by the factory in question contained 5.25% calciu fluoride; in the reaction with concentrated sulfuric acid, there was consequently a capacity to generate 2.7% hydrofluoric acid. Hydrofluoric acid vapors are exceedingly soluble in water and upon contact with moist objects they were completely trapped. Leaf damage occurred when sulfuric acid was experimentally poured over two grams of calcium fluoride and the vapors generated were fumigated over a plant.

Further observations indicated that a very rapid condensation of the acid vapors occurs in the presence of a moist atmosphere. The presence of fluorine was determined in almost all lead samples from the area in the vicinity of the factory.

25769

Davis, Donald D.

AIR POLLUTION AND SOUTHERN FORESTS. Forest Farmer, 29(10):6-7, 18, Oct. 1970.

The most common pollutants capable of causing injury to forest trees include sulfur dioxide, fluoride compounds, and oxidants such as ozone. A major source of SO2 is the burning of coal, petroleum, or gas; petroleum refining, smelting and refining of ores, and the utilization or manufacturing of sulfur containing compounds may als produce SO2. Common sources of fluorides include petroleum refineries, aluminum reduction smelters, and steel manufacturing plants. In the South, a major source is phosphate fertilizer plants. Concentrations of ozone high enough to cause plant injury may result from thunderstorm turbulence which brings oxidants down from the upper stratosphere. Compounds emitted from automobiles an industries react chemically in the air under the influence of sunlight, yielding large quantities of oxidants. Topographic features, such as the large mountain ridges typical of areas of Kentucky, North Carolina, Tennessee, and Virginia, help in trapping these pollutants. Acute injury to conifer needles is usually seen as death and browning of the needle tips or the entire needle, while chronic injury is often seen as a yellowing, dwarfing, and premature shedding of the needles. Chronic O3 injury often causes a mottled appearance to the needle. Some differences among SO2, hydrogen fluoride, and O3 injury to broadleaved plants are cited. Such factors as leaf age, environmental conditions, length of exposure time, herbicides, insects, and fertilizers also may influence symptom development. It is likely, too, that air pollution is responsible for secondary effects, such as predisposing trees to attack by those insects or fungi which are more aggressive on weakened trees.

25865

Palm, Einar W.

WHAT AIR POLLUTION DOES TO YOUR PLANTS. Crop Soils Mag., 24(3): 14-17, Jan. 1971.

Air pollution causes an estimated $500 million in plant losses each year. The invisible chemicals, such as sulfur dioxide, hydrogen fluoride, ozone, nitrogen dioxide, ethylene, and peroxyacetyl nitrates in smog are much more injurious to plants than the black emission from smokestacks, diesel trucks and buses. Plants injured by air pollution will be more susceptible to parasitic diseases, while diagnosis is often complicated because two or more chemicals may work together to increase the injury. Some pollutants, such as ozone, will react differently on different species or even varietie of the same plant species. Sulfur dioxide, produced in the smoke stacks of industrial plants, can be a double threat. The chemical itself is damaging to plants, and it may also combine with moisture to form droplets of sulfuric acid which can injure plant tissues. Certain indicator plants can be used to help determine what pollutants are the cause of plant injury. Finding a plant variety or substitute crop that is less susceptible to foul air is one step that can be taken, or high-value crops might be sprayed with pollution-reducing materials such as ozoban and ascorbic acid. Plant breeding in the future will be directed toward the identification, selection, and production of plants which can actually filter pollutants out of the air. However, government, industry, and our universities must work together to reduce the toxic materials in our air. Sources, plant response, and symptoms are presented tabularly for sulfur dioxide, hydrogen fluoride, hydrogen chloride, nitrogen dioxide, ozone, peroxyacetyl nitrate, ethylene, and particulate matter.

25945

Shupe, J. Le Grande

THE CHEMISTRY, HISTOLOGY, AND ROENTGENOLOGY OF THE TEETH AND BONES OF LARGE ANIMALS. A.M.A. Arch. Ind. Health, 21(4):346-347, April 1960.

When more than 50,000 cattle and sheep were classified according to effects of fluroide, it became evident that molar teeth were of importance in evaluating fluorosis, but the examination of the area was difficult. It was important not to confuse a black discoloration with the stain due to fluoride, which cannot be scraped from the surface of the teeth. Some areas of compact bone showed increased numbers and closer concentration of haversian canals, suggestive of new bone formation and bone reconstruction. Definite microscopic abnormalities were observed only in those bones that contained as much as, or more than, 4000 parts of fluoride per million. Abnormalities were characterized roentgenologically by an increased density or apparent abnormal porosity of bone, periosteal feathering and thickening, increased trabeculation, thickening of the compact bone and narrowing of the marrow cavity.

26055

Hanson, George P.

MAN AND AIR -- THREATS TO PRAIRIE SURVIVAL. Lasca Leaves, 20(4):78-81, 92, Dec. 1970. 6 refs. (Presented at the Prairie Conference, 2nd Midwest, Madison, Sept. 20, 1970.)

Most pollutants enter the leaf through tiny pores in the leaf surfaces and cause internal leaf damage. These tiny pores or stomates are the passages through which gas exchanges take place during photosynthesis and respiration. At a given pollutant level, other things being equal, a plant growing under conditions of high humidity will take in more pollutant and become more severely damaged than a plant growing under arid conditions. Once the pollutants have entered the leaf, each has its own characteristic type of interaction with the plant tissues. Small animals living along a busy highway could accumulate lead by consuming lead-containing herbage or breathing lead laden air. Fluoride air pollutants damaging to plants are hydrogen fluoride and silicon tetrafluoride. The characteristic symptom of fluoride damage is necrosis on leaf tips and margins where the fluoride has been concentrated. Ethylene causes a general reduction in growth, decreases apical dominance, and stimulates lateral development. Ozone enters through the stomates and attacks the palisade tissue, while sulfur dioxide enters the leaf through the stomates and reacts with water on the moist cell surfaces to form sulfite which is in turn slowly oxidized to sulfate. Peroxyacetyl nitrate enters the leaf through the stomates where it attacks the cells of the spongy mesophyll, and nitrogen dioxide causes growth reduction and defoliation at concentrations often present in polluted areas. Air pollution is having a detrimental economic effect on agriculture in the nation, while also altering the ecological relationships of plants and animals. Fortunately, most species have a great wealth of genetic variation in sensitivity to air pollution. The mechanism of plant tolerance to air pollutants is mentioned.

26092

Osterli, Victor P.

EFFECTS OF AIR POLLUTION ON AGRICULTURE AND FORESTRY: ANIMALS. In: Project Clean Air. California Univ., Berkeley, Task Force No. 5, Section 3, 3p., Sept. 1, 1970. 6 refs.

Serious economic losses have occurred when animals have been subjected to certain metallic compounds. Symptoms of fluorosis, which occurs when the diet contains more than 30 to 40 ppm of fluorides per day, include excessive wearing of the teeth, staining pitting of the enamel, and exposure of the dentine. In severe cases, joints may become enlarged and bone density increases significantly. Pasture grasses collected at the intersection of two U. S. highways near Denver contained 3000 ppm lead, while grasses collected next to a less travelled roadway contained 700 ppm lead. Suggested research needs with respect to lead pollution and its effects on animals would include the relative availability of lead to humans and animals from the different sources (air, water, and soil) and the transfer mechanism involved; the relative importance of surface contamination and absorption of lead; and whether the lead content of plants comes only from the air or also is taken up from the soil.

26158

Osterli, Victor P.

EFFECTS OF AIR POLLUTANTS ON AGRICULTURE AND FORESTRY: PLANTS. In: Project Clean Air. California Univ., Berkeley, Task Force No. 5, Section 2, 23p., Sept. 1, 1970. 174 refs.

The effects of air pollutants on plants are usually noted on the leaves because they are the site of gas exchange and photosynthesis. Pollutants often produce characteristic markings on a given plant species, providing a means of pollutant identification. Severity of injury varies with pollutant, concentration, duration of exposure, and plant species. Specific effects are cited for sulfur dioxide, fluorides, photochemical oxidants, oxides of nitrogen, ethylene, pollutant combinations, and particulates. A recent estimate of air pollution damage to California crops is reported at $44.5 million annually. Increased attention must be given to the following research needs: improved accuracy in the assessment of economic losses to agriculture and forestry resulting from air pollution; the growth depression effect on plants due to long-term low-level exposure to ethylene, sulfur dioxide, fluoride, and oxides of nitrogen; the synergistic effect of combined sublethal concentrations of air pollutants on plants; the effects of air pollutants on biochemistry, metabolism, and anatomy of plants; the relative sensitivity of the various needle-leaf species; the quality of the forest air environment; the impact of long-term oxidant exposure on growth; and more accurate methods for determining the extent and severity of smog damage.

26175

Pollanschuetz, J.

OBSERVATIONS ABOUT THE SUSCEPTIBILITY OF VARIOUS KINDS OF TREES WITH RESPECT TO EMISSION OF SO2, HF, AND MAGNESITE DUST. (Beobachtungen ueber die Empfindkichkeit vershiedener Baumarten gengenueber Immissionen von SO2, Hf and Magnesitstaub). Air Pollution Proc. First European Congr. Influence Air Pollution Plants and Animals, Wageningen, Netherlands 1968. p. 371-377. Translated from German. Belov and Associates., Denver, Colo., 10p., Oct. 13, 1970.

Investigations were conducted to determine the degree of growth inhibition in various forest trees exposed to hydrogen fluoride emissions alone or to simultaneous emissions either of hydrogen fluoride and sulfur dioxide or sulfur dioxide and magnesite dust. Trees susceptible to SO2, and Mg are, in increasing order of susceptibility, larch, pine, spruce, fir, and beech. Trees susceptible to SO2 and HF are in increasing order of susceptibility, aspen, ash, beech, maple, spruce, pine, and larch. Susceptibility to HF increases in the order pine, spruce, fir. Unlike spruce trees, pines show no noteworthy individual differences in resistance to air contaminants. Resistance in spruce is affected by factors such as location and water and nutrient supply. The need to develop resistant strains of spruce is indicated by the importance of the tree for the European forest economy.

26491

Hajduk, T.

CHANGES OF PLANT CULTURES ON AREAS IN REGION OF THE INFLUENCE OF FLUORINE EMISSIONS. (Zmeny fytocenoz natrvalych plochach voblasti posobenia fluorovych exhalatov). Text in Czech. Ochrana Ovsdusi, vol. 11-12:177-181, 1969. 12 refs.

The results of a study of qualitative and quantitative changes of plant cultures in the area of fluorine emissions from an aluminum plant are presented. Emissions considered included hydrogen fluoride, carbon tetrafluoride, and solid fluorides as well as carbon monoxide, sulfur dioxide, and similar toxic compounds. The circular experimental surface areas (r equals 2.5m) placed at 100-200 m intervals in 3 directions from the emission source were regularly investigated. As criteria of change sociability coverage, coefficient of relationship, and domination were used. The number of plant species changed in an irregular fashion with the distance from the emission source and with length of exposure to emissions with the exception of a route going through an even flat terrain. The coefficient of relationship behaved in a similar manner. The total coverage decreased towards the epicentrum and with the length of exposure to emissions. An exception was trifolium rubens, which is a species resistant to fluorine emissions. The frequency and coverage of certain species of the Daucaceae and Asteraceae family also increased. Qualitative changes of plant cultures on varying terrain thus occur irregularly, while on even terrain they bear a certain relation to the distance from the emission source. The changes so far observed were of a quantitatitve nature. Within a few years, extensive qualitative changes are expected in the area with deposits higher than 500 kgf/square km per year.

26691

Miller, V. L., Folke Johnson, and D. F. Allmendinger

FLUORINE ANALYSIS OF ITALIAN PRUNE FOLIAGE AFFECTED BY MARGINAL SCORCH. Phytopathology, vol. 38:30-37, 1948. 30 refs.

A new non-parasitic disease of Italian prune trees characterized by marginal scorch and leaf spot appeared in certain areas of western Washington. In an investigation of the cause of the condition, it was shown by chemical analysis that leaves from trees grown in the affected areas were abnormally high in fluorine, as compared with leaf samples collected from other localities where this condition does not occur. The analyses from six samples collected 90 miles or more from an aluminum factory ranged in fluorine content from 6 to 15 ppm, while 76 samples from areas within 20 miles of an aluminum factory varied between 30 and 1400 ppm of fluorine. Within a given area the amount of marginal scorch was approximately

proportional to the fluorine content of the leaves. The fluorine content of the prune leaves returned to near normal and marginal scorch of the leaves did not appear during the growing season following the closure of the two aluminum factories in Tacoma and Troutdale, Oregon. The evidence indicates that some fluorine is stored in dormant twigs, but is not translocated to any great extent into the growing leaves (Author summary)

26711

Hill, A. C., L. G. Transtrum, M. R. Pack, and A. Holloman, Jr.

FACILITIES AND TECHNIQUES FOR MAINTAINING A CONTROLLED FLUORIDE ENVIRONMENT IN VEGETATION STUDIES. J. Air Pollution Control Assoc. 9(1):22-27, May 1959. 14 refs. (Presented at the Air Pollution Control Assoc., 51st Annual Meeting, Philadelphia, Pa., May 25-29, 1958.)

Facilities were designed primarily for studying the effects over a long period of time of the low gaseous fluoride concentrations that may be found in certain atmospheres. The air circulating through each of three greenhouses is first drawn through lime- coated orlon bags to remove fluorides, while the air enters each greenhouse at 7 sites equally spaced along the base of one side. It is exhausted through 7 ducts located beside the inlet ducts, which tends to give the air a circular motion. Rapid air circulation is essential for the maintenance of the atmospheric fluoride concentrations as well as for the control of temperature and humidity. The greenhouses are cooled for circulating cold water though banks of finned coils in the air inlet ducts, and they are heated during the winter months by circulating hot water through the coils. Portable chambers of two different sizes are used for placing over crops growing in the greenhouses. These chambers are made of transparent vinylite sheeting, attached to aluminum frameworks with hardwood strips. Air flow measurements are discussed, as well as the method of injecting gaseous fluoride into the air stream. Very complete measurements have been made to evaluate the effects of hydrogen fluoride treatments on plants. These include photosynthesis measurements and periodic observations of the chlorophyll content and respiration rate of the leaves of several plant species.

26717

Leone, Ida A., E. Brennan, and R. H. Daines

ATMOSPHERIC FLUORIDE: ITS UPTAKE AND DISTRIBUTION IN TOMATO AND CORN PLANTS. Plant Physiol., 31(5):329-333, 1956. 13 refs.

Soil grown tomato and corn plants were subjected to hydrogen fluoride administered at various time-concentration levels designated as long-low, intermediate, and short-high fumigations, with the purpose of tracing the fate of the fluoride accumulated within the plants. Injury appeared more severe when the fluoride gas was administered in a short-high concentration dosage than when this same amount of gas was administered over a more protracted period. Corn was the more sensitive of the two species. As the fumigation level was increased, there was an increased fluoride accumulation. Tomato has a fluoride accumulating capacity approximately twice that of corn under all circumstances. Mature leaves accumulated greater quantities of fluoride than did younger leaves as a result of the more protracted fumigations. At the shorter higher level fumigations, the ratio of fluoride in mature to that in young corn leaves decreased to a certain point and then leveled off, whereas in tomato the ratio continued to decrease as fluoride concentration was increased. Washing the foliage removed even more fluoride than did natural diffusion. (Author summary)

26718

Compton, O. C., L. F. Remmert, and G. R. Spencer

SUMMARY REPORT OF FLUOROSIS INVESTIGATIONS IN THE SAUVIE ISLAND ARE IN OREGON FROM DECEMBER 1, 1951 TO JUNE 30, 1953. Washington Stat Coll., Pullman, Coll. of Veterinary Medicine and Oregon State Univ. Corvallis, Agricultural Experiment Station, 38p., Dec. 1953. 7 refs.

An investigation was made from December 1951 to June 1953 to determine if fluorine emanations from an aluminum reduction factory at Vancouver, Washington, were impairing the functioning or health of livestock on Sauvie Island, Oregon. The study included physical examinations of cattle and fluorine analyses of bones, teeth, soft tissues, and urine. The fluorine contents of pasture herbage, hay, silage, grain concentrate feeds, and drinking waters were determined to permit an estimate of total fluorine intake by cattle and a comparison with results from control areas. In addition, the relative fluoric contamination of the atmosphere was studied through use of indicator plants. The fluorine content of pasture herbage was not high enough to be considered deleterious to livestock; fluorine contamination of the atmosphere on Sauvie Island was of low magnitude and short duration. In most instances, grain concentrate feeds contributed a high percentage of total fluorine intake by cattle. There appeared to be no impairment of animal health from fluorosis, all symptoms of the disease being traced to other causes. (Author summary modified)

26734

Shupe, James L.

FLUOROSIS OF LIVESTOCK. American Petroleum Inst., New York, Div. o Environmental Affairs, No. 69-4, 29p., Feb. 1969. 30 refs.

Various factors such as the level and duration of fluoride ingestion, type and solubility of fluoride ingested, age of animal, level of nutrition, stress factors, and individual biological response govern the reactive processes of animals ingesting fluorides. Fluorine has beneficial effects when ingested in small amounts, but toxic and adverse effects when ingested in excessive amounts. One must be aware of variables and conversion factors in the application of data from one species to another, or one age group to other age groups within a species and of the hazard of interpreting data only at the clinical level without correlating it with tissue and cellular levels. Fluorosis in livestock can be prevented and controlled but only when the complexity of the diseas is realized and the symptomatology, pathogenesis, and lesions are properly correlated, interpreted, and evaluated. The tooth classification and the amount of fluorine in bone can be used to predict the extent of fluorosis with a high degree of accuracy. When properly interpreted, urinalyses can be an aid in diagnosing fluorosis and can be us ful in roughly estimating current fluorine intake. Tolerances of fluorine for young and matured livestock under various conditions have been established and a comprehensive guide has been developed and compiled to facilitate diagnosing and evaluating fluorosis. Recommended standards are presented tabularly. Fluorine in stack emissions and ambient air should be determined so that these data may be correlated insofar as possible with the degree of fluorosiis observed in livestock. (Author summary modified)

26742

Phillips, Paul H. and John W. Suttie

THE SIGNIFICANCE OF TIME IN INTOXICATION OF DOMESTIC ANIMALS BY FLUORIDE. A.M.A. Arch. Ind. Health, 21(4):343-345, April 1960. 9 refs.

A considerable body of evidence indicates that there is a time interval between the initiation of a significant increase in the ingestion of fluoride by domestic animals and the onset of intoxication by fluoride. This interval has been aptly referred to as the 'lag' or latent period in the toxic syndrome. Three physiologic mechanisms tend to protect the soft tissues against a significant rise in the concentration of fluoride. They are excretion through the kidneys, prompt deposition in the skeletal structures, and the voluntary refusal by the animal of feeds contaminated with fluoride. Inhibition or retardation of either or both urinary excretion and skeletal deposition leads to increased concentrations of fluoride in the soft tissues. Hence, a reduction in the rate of these mechanisms of soft tissue protection, to the point of insufficiency, provides the basis for the development of fluoride intoxication. Data are presented which show the relationship between time and dose in the development of intoxication following the finding of fluoride. The lower the dose, the longer is the time; conversely, the higher the dose, the shorter the time required to induce intoxication. (Author summary modified)

26795

Velu, H.

DARMOUS. SPONTANEOUS FLUOROSIS OF PHOSPHATED AREAS. (Le darmous. Fluorose spontanee des zones phosphatees). Text in French. Arch. Inst. Pasteur Alger., 10(1):41-118, March 1932. 50 refs.

The Arabic name of Darmous is given to a disease of domesticated animals that occurs in certain sections of the North African countries of Algeria, Tunisia, and Morocco. The occurrence of the disease is most frequent in areas where there is an abundance of phosphates, and is characterized by dental dystrophy, which appears just after the weaning of young animals. On the basis of a series of observations and testing, the author's conclude that the disease is a fluorosis, since fluorine is almost always present in phosphate mineral deposits. The disease is considered dangerous to humans, since the meat of sheep raised in these areas, when fed to white rats, increases their mortality.

26800

McNulty, Irving B. and David W. Newman

EFFECTS OF ATMOSPHERIC FLUORIDE ON THE RESPIRATION RATE OF BUSH BEAN AND GLADIOLUS LEAVES. Plant Physiol., 32(2):121-124, 1957. 17 refs.

Bush beans and gladioli were exposed to known concentrations of atmospheric fluoride and the respiration rates of their leaves was measured manometrically. Fumigation resulted in an increase in leaf respiration of bush bean plants after a minimum of eight days at 30 ppb atmospheric fluoride concentration. Middle-aged and old leaves showed a greater increase in respiration than young leaves. Gladiolus leaves fumigated at 2.4 ppb for 25 days showed a high degree of stimulation of respiration of the chlorotic tissue next to the scorched area, and a lower but significant stimulation of respiration on tissues 5 cm from the dead area. Liming the leaves of gladiolus plants did not affect their respiration rate, and did protect them against fluoride damage. (Author summary modified)

26861

Brandt, C. Stafford

EFFECTS OF AIR POLLUTION ON PLANTS. In: Air Pollution. Arthur C. Stern (ed.), Vol. 1, New York, Academic Press, 1962, Chapt. 8, p. 255-281. 38 refs.

Visible injury symptoms on the leaves of plants attributable to air pollution can be considered in three general categories, not necessarily mutually exclusive: leaf tissue collapse, chlorosis or other color changes, and growth alterations. In many of the cases the injury pattern developed is highly characteristic of the toxic agent, but while characteristic, the pattern is by no means specific for the agent. Disease, insects, nutrition, and other factors can produce leaf patterns very similar to those produced by air pollutants. Problems of diagnosis are considered. Symptoms are discussed for injury due to sulfur dioxide, fluorides, ozone, oxidant smog, and several other pollutants, such as ethylene. Significant points in the symptomatology of air pollution on vegetation are summarized for these compounds. These include leaf markings, similar markings, concentration levels, and the sensitivity of indicators. Hidden injury and physiological effects are also considered. Field surveys are discussed.

26876

National Academy of Sciences--National Research Council, Washington D. C., Subcommittee on Fluorosis Problems

THE FLUOROSIS PROBLEM IN LIVESTOCK PRODUCTION. NAS-NRC-Pub-381, 25p., Sept. 1955. 105 refs.

Present information on fluorosis is reviewed with respect to its appearance in livestock. The recognized sources of fluorine which may affect livestock are mineral feed supplements; water contaminated by fluorides; forage contaminated by soil particles of high fluorine content; or forage contaminated by atmospheric fluorides from industrial plants. The development of fluorosis in livestock depends on the availability and level of the ingested fluorine; the length of time of exposure; skeletal storage; the age of the animal; physiological stress; and the effectiveness of defense mechanisms. Excretion by the kidney, deposition in the bones, and limitation of intake by loss of appetite all contribute to protect the animal body from fluorine toxicosis. The most definitive quantitative measurement of fluorosis is the extent of retention of fluorine in bones and teeth. The tolerance of the animal to ingested fluorine is increased by consumption of green forage, by supplementing the ratio with certain soluble aluminum compounds, by including high levels of calcium in the ration, and by adequate nutrition.

26916

MacLean, D. C., R. E. Schneider, and L. H. Weinstein

ACCUMULATION OF FLUORIDE BY FORAGE CROPS. Contrib. Boyce Thompson Inst., 24(7):165-166, 1969. 5 refs.

Portions of mixed timothy and red clover exposed to hydrogen fluoride that averaged 7.0 micrograms F/cu m over a 14-day period rapidly accumulated F, attaining a concentration of more than 100 ppm within three days and about 400 ppm by the end of exposure. The plants showed severe HF-induced foliar symptoms. Forage exposed continuously to a HF concentration that averaged 1.6 micrograms over the 14-day period accumulated 37 ppm F by the end of exposure. In contrast, forage exposed intermittently to a 14-day mean concentration of 1.9 micrograms F/cu m accumulated 101 ppm F after only 1- day of exposure. However, there were no discernible differences in the extent and severity of foliar injury following continuous low and intermittent HF exposures. Presumably the intermittent nature of the exposure provided sufficient time for the detoxification of the absorbed F. These data suggest that F accumulation by forage is at best a poor indicator of fluoride pollution, except when used for the protection of livestock or confirmation of suspected fluoride-induced foliar symptoms.

26978

Kazantseva, E. N.

RESISTANCE OF SOME GRASSES TO FLUORINE. In: American Institute of Crop Ecology Literature. Effects and Symptoms of Air Pollutes on Vegetation; Resistance and Susceptibility of Different Plant Specie in Various Habitats, in Relation to Plant Utilization for Shelter Belts and as Biological Indicators. M. Y. Nuttonson (ed.), Vol. 2, Silver Spring, Md., American Institute of Crop Ecology, 1969, p. 56-59, 4 refs. (Also: Okhrana Prirody na Urale, 1966:45-47.)

Experiments were set up in an aluminum plant to select some grasses resistant to fluorine. Test pilots were located near the electrolysis shop where the concentration of fluorine was 0.612 mg/cu m, while the control plots were located at a distance some 2000 m from the source of pollution. Additional experiments were conducted in chambers where the plants were fumigated for 8 hours with concentrations of 0.8 and 0.03 mg/cu m. The species planted were as follows: meadow fescue, red fescue, Kentucky bluegrass, perennial ryegrass, meadow foxtail, timothy grass, redtop, awnless bromegrass, meadow brome, and roegneria. Observations were recorde regarding damage to the leaves and the plant height was noted in relation to the fluorine concentration. The water retention abilit of leaves was studied, and the quantity of oxidizable substances was determined. At the end of the growing period, injury to the meadow foxtail, awnless bromegrass, meadow brome, and roegneria was 50-60%. The least injury (25-35%) was noted with Kentucky bluegras and red fescue. Compared with the control plants, the plants grown at the aluminum mill were smaller. The species having the greater water retention capacity were least injured. Determination of oxidizable substances in the cell content showed that meadow fescue has the least amount of them, whereas redtop the largest. Meadow fescue, red fescue, and Kentucky bluegrass are recommended as suitable for planting in the industrial areas having the highest fluorine concentrations.

27006

Weinstein, Leonard H. and Delbert C. McCune

EFFECTS OF FLUORINE ON AGRICULTURE. Preprint, Air Pollution Contro Assoc., Pittsburgh, Pa., 14p., 1970. 32 refs. (Presented at the Air Pollution Control Association, Annual Meeting, 63rd, St. Louis, Mo., June 14-18, 1970, Paper 70-154.)

Certain effects of fluorine on plants can be regarded as objective since they have been derived from laboratory experimental data, field observations, and the body of botanical knowledge. Agricultural effects, on the other hand, are to a great extent hypothetical and subjective. The three general classes of possible effects of fluorine on agriculture are decreased commercial value of the product, increased cost of production, and decreased value of farming facilities. While experimental data cannot be used to predict all the fluorine effects that might occur in the field, experimental procedures do permit the identification and prevention of agricultural effects. The latter can then be the subject of limited field trials and surveys.

27021

Krueger, E.

DETECTION OF FLUORINE IN PLANTS DAMAGED BY SMOKE. (Ueber den Nachweis von Fluor in rauchbeschaedigten Pflanzen). Text in German. Metall u. Erz, 38(11):265-266, June 1941. 5 refs.

Fluorine damage caused by emissions of smelting plants, super- phosphate factories, and a chemical factory was investigated by anatomical studies of plant leaves, stems, and blooms. The differentiation between plant damage caused by fluorine and sulfur dioxide was found to be difficult and unreliable. Microchemically, fluorine was detected by the ammonium molybdate method and by the sodium fluosilicate method; the latter was more reliable. In cases where fluorine was detected in undamaged plants the fluorine was actually in the dust covering the plants. To ascribe plant damage to fluorine emissions is easy where one isolated source of fluorine exhalations exists; where fluorine is emitted together with SO2 from several sources the fluorine test is not conclusive. In such cases an experienced expert must consider all pertinent factors and form a judgment.

27030

Bingham, F. T., R. C. McColloch, G. F. Liebig, and A. P. Vanselow

FLUORIDE INJURY TO CITRUS. Calif. Agr., vol. 8:12, 15, May 1954.

Foilage from approximately 130 citrus groves was sampled for fluoride analysis. Approximately 1 ppm F was found in areas considerably removed from industrial centers. In the Los Angeles area, a gradual increase in leaf fluoride concentrations took place with the approach to the heavily industrialized district in and around Sante Fe Springs, Whittier, and San Gabriel. Fluoride levels as high as 57 ppm F were found. The largest source of airborne fluorides affecting vegetation in the San Bernardino Valley appeared to be a steel plant. Thery was a greater increase in fluoride during the July to October interval than from January to March. Foliar concentrations of fluoride increased very little once the winter rains began.

27091

Nikolaevskiy, V. N.

INDICATORS OF GAS RESISTANCE OF ARBOREAL PLANTS (ACCORDING TO INVESTIGATIONS CONDUCTED IN THE CITY OF KRASNOURAL'SK). In: American Institute of Crop Ecology Survey of USSR Air Pollution Literature. Vol. 3, Silver Spring, Md., American Inst. of Crop Ecology, 1970, p. 70-94. 30 refs. (Also: Tr. Inst. Bid. Ural. Filial Akad. Nauk USSR., vol. 31:59-79, 1963.)

Two hundred trees in an industrial city heavily contaminated with sulfur dioxide and fluorine compounds were studied for their degree of gas resistance. The trees included aspen, balsam poplar, box elder, crab apple, and white birch. The studies were made in the summer and covered the following physiological processes: photosynthesis, respiration, transpiration, activity of the stomas, quantity of easily oxidizable substances, water holding capacity of the leaves, cell pH content, concentration of dry matter in leaves, and anatomical features of leaf structure. Intensity of the basic physiological processes was, to a significant extent, connected with the functioning of the stoma apparatus, reduction of the stoma apertures drecreasing the rate of gas exchange. The gas-resistant box elder was characterized by smaller stoma apertures and by low intensity of photosynthesis and respiration during the growing period. In contrast, intensity was high in the greatly susceptible birch and crab apple. Although the highest transpiration intensity was found in the box elder, transpiration does not appear to be a reliable index of gas resistance. Total leaf water content correlated well with susceptibility to gas damage. Gas resistant species were also characterized by a smaller amplitude of fluctuations of the amount of oxidizable matter and by smaller amounts of this matter, by lower concentrations of dry matter, and by less decrease in cell pH content.

27303

Richards, B. L. and O. C. Taylor

STATUS AND REDIRECTION OF RESEARCH ON THE ATMOSPHERIC POLLUTANTS TOXIC TO FIELD GROWN CROPS IN SOUTHERN CALIFORNIA. J. Air Pollution Control Assoc., 11(31):125-128, March 1961. 31 refs. (Presented at the Air Pollution Control Association Annual Meeting, 53rd, Cincinnati, Ohio, May 22-26, 1960.)

Atmospheric pollutants in the Los Angeles area toxic to vegetation are becoming more clearly defined and their vegetational suscepts determined. Ozone and peroxyacetyl nitrite (PAN), each with a high oxidizing and phytotoxic potential, are now known to be toxic to vegetation. Further, it is becoming obvious that these oxidants are essentially reaction products of atomic oxygen formed by photolysis of nitrogen dioxide with a wide range of hydrocarbons Whether sublethal or subnecrotic concentrations of fluorides cause economic damage in sensitive plants remains to be determined, as do the effects of the other phytotoxicants on crops under field conditions. These are the objectives of the Agricultural Air-Research Program of Southern California, which will conduct field evaluations of the effects of PAN, ozone, and fluorides on yields, growth, and quality of fruits and other agricultrual products. Hopefully, the field studies will be implemented by the development of refined sampling and recording techniques for oxidants and fluorides.

27324

Strong, Forrest C.

TOXIC GASES EFFECT GN PLANT LIFE. Am. Foundryman, 19(3):55-57, March 1951. 9 refs.

If the coal or coke in foundry cupola operations is not properly combusted, sulfur dioxide may be produced in such concentrations as to cause acute or chronic injury to plants under conditions of intense daylight, high humidity, and high temperature, especially when there is slow movement of the air. Plant species vary in their relative susceptibility to SO2 injury, e.g., pine is injured by 2 ppm, beech by 33 ppm, and roses by 2-4 ppm. Dusts may cause clogging of the leaf pores, preventing normal air exchange, or cover the leaf surfaces to such an extent as to reduce photosynthetic activity. Fluorine compounds will escape as effluents when fluorspar and cryolite are used as fluxing materials, accumulating in the tissues of the leaves and causing severe injury especially during dry periods. Injury to plant tissues appears in the form of marginal leaf burning, that is, a killing of the tissues with resultant browning, followed by unseasonably early leaf fall. The normal processes of plant photosynthesis and respiration are reviewed. (Author summary modified)

27526

Weinstein, Leonard H. and Delbert C. McCune

EFFECTS OF FLUORIDES ON VEGETATION. Preprint, Air Pollution Control Assoc., Toronto, Ontario Section, Air Pollution Control Assoc., Pittsburgh, Pa., TR-7 Agricultural Committee, and Ontario Dept. of Energy and Resources Management, Toronto, Air Management Branch, 31p., 1970. 99 refs. (Presented at the Impact of Air Pollution on Vegetation Conference, Toronto, Ontario, April 7-9, 1970.)

Fluorides are emitted in both gaseous and particulate forms in the manufacture of phosphate fertilizers, brick, ceramics, glass, enamel frit, beryllium, aluminum, steel, nonferrous metals, and from other sources. Hydrogen fluoride and silicon tetrafluoride ar the predominant gaseous forms and represent the most important form of fluoride injurious to vegetation. Symptoms induced by atmospheric fluoride on broad- and narrow-leafed plants are described, and effects on growth, yield, and reproduction are discussed. Other important factors influencing symptom expression and growth effects, such as stage of development of the plant, specific and varietal differences, environmental effects, concentration of fluorides in the atmosphere, and duration and frequency of exposure, are also reviewed. Enforcement of an air quality standard for fluoride will require sampling not only of air but also of native or economically important vegetation. Methods of concentration, separation of gaseous and particulate forms, and determination are noted. (Author abstract modified)

27785

Cormis, Louis de

EFFECT OF INDUSTRIAL AIR POLLUTION ON VEGETATION. (Effet sur les vegetaux de la pollution de l'air d'origine industrielle). Text in French. Ann. Mines (Paris), no. 11:15-20, Nov. 1970.

The two major pollutants of plants are sulfur dioxide and fluorine compounds. SO2 causes necrosis of leaves but the vegetation resumes after the pollution wave has subsided. The killing of tree or of shrubs has never been observed. Under conditions of maximal photosynthesis and of high relative humidity, the noxious effect of SO2 is at its peak. At a subnecrotic level of SO2, plants absorb SO2, then re-emit part of it as SO2, another part as hydroge sulfide, and absorb a third part which appears in sulfates, proteins, and in sulfonated aminoacids. The absorption of SO2 and its reduction by the plant is tied to the photosynthetic activity of the plant. Fluorine compounds in the atmosphere cause leaf necrosis at 10 to 1000 times lower levels than SO2. In contrast to SO2, necrosis develops slowly from the periphery to the center of the leaves. Fluorine ions do not participate in plant metabolism at any level. Since some highly necrotic leaves exposed to fluorine contain only traces of F (20 to 40 ppm) while leaves of other plants contain up to 1000 ppm F without signs of necrosis, analytical findings are of no use in the determination of the effec of fluorine on vegetation. A high level of fluorine in the atmosphere will kill plants. Effects of pollutants on vegetation cannot be predicted because they depend, in each case, on crop, locality and growth season.

27805

Pack, Merrill R.

EFFECTS OF HYDROGEN FLUORIDE ON BEAN REPRODUCTION. Preprint, Air Pollution Control Assoc., Pittsburgh, Pa., 20p., 1970. 12 refs. (Presented at the Air Pollution Control Association, Annual Meeting, 63rd, St. Louis, Mo., June 14-18, 1970, Paper 70-134.)

Tendergreen bean plants were grown from planting to seed maturity under continuous exposure to hydrogen fluoride at fairly uniform concentrations averaging 10.5, 9.1, and 2.1 micrograms F/cu m. Progeny of these plants and of comparable control plants were grown in a clean atmosphere to determine if subsequent generations were affected by HF treatment of the parents. The F-1 generation progeny of the HF treated plants were less vigorous than control plant progeny, as shown by later emergence, smaller primary leaves, and slower stem growth. This probably was a consequence of the lower starch content of the seed of the HF treated plants. The primary leaves of some of the JF treatment F-1 progeny were severely stunted and distorted. This also may have been due to the low starch content of the seed, or perhaps it resulted from damage to the plumules in shrivelled, distorted seed produced in the HF treatment. Some of the first trifoliate leaves of many F-1

generation progeny of the HF treated plants were abnormal in the separation and number of their leaflets. This abnormality apparently was heritable, for in the next (F-2) generation it occurred most frequently among plants whose parents were abnormal. However, few F-3 generation plants had abnormal trifoliate leaves, indicating rapid reversal to normal form. (Author abstract)

27907

Schmidt, H. J., G. W. Newell, and W. E. Rand

THE CONTROLLED FEEDING OF FLUORINE, AS SODIUM FLUORIDE, TO DAIRY CATTLE. Am. J. Vet. Res., vol. 15:232-239, April 1954. 27 refs.

Dairy cattle were fed fluorine as sodium fluoride on a daily basis for a three-yr period and periodically examined for the influence of fluorine on lactation, weight, teeth, general health, and bones and tissues. The daily ingestion of fluoride levels as high as 2.5 mg/kg of body weight did not significantly reduce milk production nor cause a depression in weight. There was no evidence in the cows of diarrhea, rough coat, lapping of water, or elongation of the toes which might be attributed to prolonged ingestion of fluorides. The fourth incisors of cows fed 2.0 and 2.5 mg fluorine showed marked mottling, staining, and wear. At the 1.5-mg fluorine level these effects were less apparent. Only slight mottling and staining, with no wear, was evident in cows fed 1 mg fluorine. Third incisors were less effected by fluorine, while first and second incisors remained free of any changes. Slight exostosis developed in three of four cows fed 2.5 mg fluorine but not in cows fed lower levels. The relative intake of sodium fluoride by the animals was consistently reflected in the urinary excretion of fluorine. (Author summary modified)

27923

Newell, G. W. and H. J. Schmidt

THE EFFECTS OF FEEDING FLUORINE, AS SODIUM FLUORIDE, TO DAIRY CATTLE--A SIX-YEAR STUDY. Am. J. Vet. Res., 19(71):363-376, April 1958. 21 refs.

A six-year study was carried out to determine the effects of prolonged feeding of fluorine to dariy cows, beginning with two-yr old heifers, under conditions of practical dairy management and practice. Fluorine, as sodium fluoride, at levels as high as 2.5 mg/kg of body weight had no adverse effect on milk production or growth rate. The inseminations per conception, days in gestation, and percentage of live births were uninfluenced by the levels of fluorine used. Regardless of fluorine treatment, birth weights of calves were all within the normal ranges. The degree of dental fluorosis observed depended on the length of time on experiment, the amount of fluorine fed, and age on cow when sodium fluoride was first administered. Although the general health of the herd remained high, frequent unthriftiness and roughened coats were seen in cows fed 2.0 and 2.5 mg fluorine. Exostoses occurred on the metatarsal bones of two cows fed 2.5 mg fluorine and one of these animals subsequently exhibited lameness in walking. These results suggest that the boundary level at which toxicosis may be expected to occur over periods of prolonged ingestion is 2.0-2.5 mg fluorine. The most reliable indicator of the levels of fluorine ingested was found to be fluorine deposition in bone and cartilage.

28031

Rand, W. E. and H. J. Schmidt

THE EFFECT UPON CATTLE OF ARIZONA WATERS OF HIGH FLUORIDE CONTENT. Am. J. Vet. Res., 8(46):50-61, Jan. 1952. 14 refs.

Observations of cattle that have been continually ingesting and absorbing fluoride from drinking water and from forage provide a direct confirmation of conclusions that have been derived from a study of the literature. Levels of soluble fluoride in the diet can be tolerated as high as 1 mg per kilogram of body weight per day over a long period of time with no ill effect, except possible slight mottling and wear of the teeth. A level of soluble fluoride in the diet of the order of 2 mg per kilogram of body weight per day may result in mottling and severe wear of incisor teeth that form during the period of ingestion, as well as lameness and stiffn emaciation, and general unthriftiness. Conditions as observed in the Phoenix, Ariz., area substantiate conclusions previously drawn from the literature with respect to fluorine content of urine and bones as criteria of damage. The fluorine content of urine must be well above 10 ppm to indicate current consumption of fluorine in damaging amounts, while the fluorine content of the metacarpus must be above 4000 ppm to indicate an accumulated amount that would have any effect other than some slight mottling or wear of the incisor teeth. (Author summary modified)

28035

Schmidt, H. J. and W. E. Rand.

A CRITICAL STUDY OF THE LITERATURE ON FLUORIDE TOXICOLOGY WITH RESPECT TO CATTLE DAMAGE. Am. J. Vet. Res., 8(46):38-49, Jan. 1952. 68 refs.

A critical study of the literature was undertaken to establish the best field method for the diagnosis of fluorosis in cattle, to determine the borderline between amounts of ingested and absorbed fluorine that will be damaging and nondamaging over an extended period, and to establish the best biochemical checks for support of the diagnosis. Since there is usually no reason for examining cows' teeth, the first noticed symptoms of fluorosis in cattle may be bilateral lameness and stiffness, often accompanied by palpable exostoses on the long bones, lower jawbone, and ribs. However, prior to these first-observed symptoms, the incisor teeth will exhibit ineradicable mottling and abnormal wearing, in those cases where the teeth were formed during the period of abnormal fluoride ingestion. In pronounced or advanced cases of fluorosis, cattle may exhibit dryness and stiffness of the hide, poor condition of the coat, diarrhea, impaired appetite, decreased weight gain, lowered milk yield, emaciation, cachexia, and anemia. Bones from animals that have been damaged by fluorosis will analyze more than 3000 to 4000 ppm of fluorine, while no damage from fluorosis has been found unless the urine continuously analyzes well in excess of 10 ppm. Because of the differing ability of various forages to accumulate fluoride, and because of seasonal and other variables, a comprehensive and long term sampling and analytical program is necessary to determine total amounts of fluorides ingested. (Author summary modified)

28149

Tamaki, Takahiko, Masaki Uehara, and Yutaka Umeda

STUDIES ON THE EFFECTS OF AIR POLLUTANTS TO THE PLANTS. 1. INVESTIGATION OF THE EFFECTS OF SEA WIND TO PLANT LEAVES AT THE WESTERN PART OF GOSHIKIDAI ON THE SETOUCHI COAST. (Nosakubutsu ni taisuru kankyoosen no eikyo ni kansuru kenkyu. 1. Setouchi engan Goshikidai seibu chiiki no jittai chosa). Text in Japanese. Kagawa Daigaku Nogakubu Gakujutsu Hokoku (Tech. Bull. Fac. Agr. Kagawa Univ.), 21(48):74-83, March, 1970. 16 refs.

Ten species of plant leaves were collected July through September, 1969, at the western part of Goshikidai in Kagawa Prefecture. PH values of the cell sap obtained from ground

plant leaf tissues were determined in situ with a portable pH-meter with specially designed electrodes. The electric conductivity of the water extracts of the same plant leaves was measured with a portable electric conductometer in the laboratory. Wind direction and velocity were monitored at 18 observation stations in the area with Mori's apparatus. The effects on the pH values and specific electric conductivity of the plant leaf cell sap of the wind direction and velocity at each observation station were studied to determine the effects of sea wind. Plant cell sap samples from the observation stations affected by the sea wind showed higher pH values than others. The specific electric conductivity, on the other hand, showed no definite tendency. The duration of water extracting affected the specific electric conductivity to an extreme degree. No marked effects of air pollution on plants were determined except some minor effects of sea wind and fog. When the air pollution due to acidic gases, such as sulfur dioxide and fluorides, is enhanced by sea wind or fog, the effects on plants is expected to be serious.

28258

Shupe, James L., Arland E. Olson, and Raghubir P. Sharma

EFFECTS OF FLUORIDES ON FARM ANIMALS. Preprint, Air Pollution Control Association, Toronto, Ontario Section, and Ontario Dept. of Energy and Resources Management, Toronto, Air Management Branch, 29p., 1970. 31 refs. (Presented at the Impact of Air Pollution on Vegetation Conference, Toronto, Ontario, April 7-9, 1970.)

If animals ingest quantities of fluorides above their safe tolerance level for prolonged periods of time, fluorine toxicosis or fluorosis may result. Acute fluorosis toxicosis usually arises from accidental ingestion of extremely high levels of fluorine compounds in water, vegetation, or other feeds. Chronic toxicosis (fluorosis) is the type of fluorine poisoning most frequently observed in livestock; it is characterized by certain clinical manifestations or pathological lesions. Where fluorosis is suspected, proper sampling and chemical analysis of vegetation may give early indications of the source and extent of the problem. The degree of fluorosis can be determined with a high degree of accuracy by taking into account the amount of fluorine in bone and the tooth classification. Fluorine tolerance limits have been established for various animal species and are summarized in tabular form.

28409

Navara, Jan

A CONTRIBUTION CONCERNING EFFECT OF FLUORINE ON SEED GERMINATION IN RELATION TO THE NATURAL CONTENT OF ASH AND SOME BIOGENIC ENDS. (Prispevok k ucinku fluoru na knicenie semien vo vztahu k prirodzenemu obsahu populovin a niektorych biogennych prvkov). Biologia, 19(8):589-596, 1964. 9 refs. Translated from Russian. Belov and Associates, Denver, Colo., 11p., Jan. 2, 1971.

The effects of low and high concentrations of fluorine on the germination of seeds of peas, barley, white mustard, kohlrabi, and carrots were studied in relationship to the mineral content of the seeds. Fluorine was applied by soaking seeds for 20 hrs in various concentrations of sodium fluoride. High concentrations of fluorine inhibited germination of pea and barley seeds and, to a lesser extent, mustard and kohlrabi seeds. Seeds of poppies and carrots were relatively unaffected. For the most part low concentrations of fluorine had a stimulating effect that was apparent in speed of germination and overall ability to germinate, as well as root growth and the growth of coleoptiles. Increasing the calcium content of seeds by the application of Ca(NO3)2 decreased the inhibiting effects of fluorine on the germination process. The levels of other mineral elements in seeds appeared to have no correlation with tolerance to fluorine.

28427

Pilet, P.-E.

THE EFFECT OF FLUORINE AND OF BETA-INDOLACETIC ACID ON THE RESPIRATION OF ROOT TISSUE. (Action du fluor et de l'acide beta-indolylacetique sur la respiration des tissus radiculaires). Text in French. Rev. Gen Bot., 71(836): 12-21, 1964. 23 refs.

The effect of various concentrations of BIAA and of fluorine in the form of sodium fluoride on the growth of apical root fragments of Lens culinaris was studied. At all concentrations BIAA inhibited the elongation of the root fragments, fluorine had the same effect at high concentrations but at low concentrations had a stimulatory effect on the growth of the root fragments. BIAA was found to stimulate respiration mildly at low concentrations while it inhibited the absorption of oxygen at higher concentrations. Acting in combination no additive effect was noted. At concentrations stimulating respiration, fluorine was found to reduce the acceleration effect caused by BIAA. Thus fluorine and auxine acted as antagonists in their effect on the respiration of root fragments of Lens culinaris.

28437

ten Houten, J. G.

INFLUENCE OF AIR POLLUTION ON PLANTS. (De invloed van luchverontreiniging op planten). Text in Dutch. Neth. J. Plants Pathol., 73(4):129, 1967.

The history of plant poisoning from gaseous air pollutants in the Netherlands goes back 60 years; the first incident of this kind was damage caused by fluorine in the vicinity of a superphosphate plant. The effects of hydrogen fluoride, sulfur dioxide, and peroxyacetyl nitrate (PAN) are briefly summarized. Hydrogen fluoride, when present in quantities as low as a few parts per billion, can cause damage to the leaves of plants. Lichens are so sensitive to sulfur dioxide that they cannot exist in the vicinity of large cities and industrial centers where the SO2 concentration is higher than 35 parts per billion. PAN, sometimes known as photochemical smog, was considered an American phenomenon until October 1965, when abnormal weather conditions in western Europe caused serious damage from this pollutant to spinach and lettuce. Damage to the leaves of certain species and varieties of plants makes them valuable as indicators (their sensitivity exceeding that of the human senses), but they are less accurate than chemical analyses, due to the fact that the 'symptoms' are not entirely specific for higher concentrations. The mechanism of plant damage from air pollutants is not completely understood, although it is known for certain that fluorine, ozone, and PAN act at the level of the cells, functioning as inhibitors of the plant enzymes. Fluorine affects the metabolism of carbohydrates; enolase is especially sensitive to this gas. A combination of PAN and ozone strongly inhibits the synthesis of cellulose. Liquid and solid particles in the air can also cause damage directly or indirectly t plants, especially by limiting the incidence of sunlight.

28443

Didier, Bertrand

FLUORINE, A DYNAMIC TRACE ELEMENT FOR CORN. (Le fluor, oligo- element dynamique pour le mais). Text in French. C. R. Acad. Sci. Paris, Ser. D, vol. 269:1767-1769, Nov. 3, 1969. 7 refs.

Corn plants grown in an artificial medium containing 0, 0.5, 1, 2, and 4 mg sodium fluoride yielded after 64 days 19, 30.8, 31.4, 39.6 and 27.3 g dry weight of vegetable matter respectively. A graphic analysis of the growth curve of corn under given experimental conditions yielded 1.8 mg NaF/l as the optimal growth-promoting quantity of NaF for corn. In the presence of aluminum salts and of 0, 0.5, 1 and 4 mg sodium fluoride, after 65 days corn plants yielded 18.6, 43.26, 11.4 and 10.54 g dry weight of vegetable matter. Fluorine in trace quantities is necessary for the optimal growth of corn in an artificial medium; at higher levels, however, fluorine is toxic and inhibits growth. The toxicity of fluorine can be attenuated by an excess of aluminum in the solution as a result of the probable formation of aluminum fluoride. The optimal concentration of fluorine varies from 250 to 800 microgram/l g depending on the concentration of aluminum in the medium.

28446

Bovay, E., A. Bolay, R. Zuber, P. Desbaumes, G. Collet, J.-P. Quinche, G. Neury, and B. Jacot

THE EFFECT OF CERTAIN COMBINED BORON FERTILIZERS ON THE ACCUMULATION OF FLUORINE IN VEGETABLES. (Influence de certains engrais combines boriques sur l'accumulation du fluor dans les vegetaux). Text in French. Revue Suisse de Viticulture et Arboriculture (Lausanne), 1(2):30-33, March-April 1969. 7 refs.

Tests with grapevines, apricot trees, and forage plants performed on field lots, in potted plants, and in the laboratory disclosed that the use of certain combined fertilizers resulted in an accumulation of fluorine in the plant tissues, particularly in leaves. The fertilizers in question were manufactured by direct solubilization in a strong acid of a mixture of crude phosphates, of a potassium salt, and of a boron compound. An analysis of three different types of these fertilizers disclosed the presence of potassium fluoborate which as a result of its solubility is absorbed by the plant roots and accumulates in plant tissues. This accumulation was greatest at elevated temperatures, under strong illumination, and at low relative humidity and drought conditions, probably as a result of accelerated evapotranspiration. The manufacturers of the fertilizers in question were advised of these findings and the objectionable method of manufacture discontinued.

28474

Zuber, R., E. Bovay, M. Roulet, and W. Tschannen

ATMOSPHERIC POLLUTION AND ITS EFFECT ON THE PLANT. (Die Verunreinigung der Atmosphaere und ihr Einfluss auf die Pflanze). Text in German. Schweizerische Gaertnerzeitung (Zurich), 73(19): 233-236, May 1970.

Sulfur dioxide penetrates into the interior of leaves more readily at higher temperatures, under bright light, and at high humidity than in cold and dry weather and in darkness. The plant has a defensive mechanism in that it oxidizes the sulfite ion to a sulfate ion 30 times less toxic. Fluorine emissions from aluminum works, glass works, brick factories, ceramic factories, phosphate fertilizer plants, and from the manufacture of hydrofluoric acid can be controlled by the Harding-Desbaumes device which absorbs not only gaseous fluorine compounds but partly also solid fluorine compounds in dust and in aerosol. Fluorine is absorbed by plants principally through leaves, and only to a small degree through root from the soil. Its distribution in the plant is uneven, with content high in roots, leaves, and stems. Fluorine compounds cause plasmolysis of the cell content and thus the death of cells manifested by necrotic plant tissue. Chlorine and hydrochloric acid, which cause burns in plants, now contaminate the atmosphere only rarely; ammonia has a similar effect. Dust from cement factories and metallic oxide dust cause plant necrosis. Of automobile exhaust pollutants, saturated hydrocarbons, nitrogen oxides and organic acids are less phytotoxic, while ozone, nitro-derivatives, and peroxyacetyl nitrate are more so. Lead emissions do not seem to cause severe damage to plants even at high levels but are dangerous indirectly to animals and humans.

28475

Bovay, Ernest

THE EFFECTS OF AIR POLLUTION ON PLANTS. (Effets de la pollution de l'air sur les plantes). Text in French. In: Probleme der Luftverunreinigung durch die Industrie. Switzerland, Vogt-Schild S. A., 1969, p. 1-19. 126 refs.

A review is presented of sources of SO2, methods of measuring it in the atmosphere, maximal permissible SO2 levels, its mode of action on plant tissues, contributory factors, sensitivity of species and plant organs and methods of evaluating damage caused by SO2, including inspection, air analysis, analysis of the affected tissues, microscopic examination, and turbidimetric tests. Some of the same subjects are also discussed for fluorine emissions. Damage from these and other pollutants, including chlorine, hydrochloric acid, ammonia, hydrogen sulfide, zinc oxide dust, dust from cement plants, compounds of arsenic and molybdene, coal tar fumes, automobile emissions, ozone, peroxyacetyl nitrate, and smog, to a variety of plants is described.

28476

Viel, M. G. and M. L. de Cormis

THE EFFECTS OF SULFUR DIOXIDE AND OF FLUORINE COMPOUNDS ON VEGETATION. (Action de l'anhydride sulfureux et des composes fluores sur la vegetation). Text in French. Poll. Atmos. (Paris), vol. 7:381-391, 1965. 20 refs. (Presented at the Conference Internationale des Arts Chimiques, Paris, France, 1965.)

The study of the effects of SO2 and HF pollution on crops and vegetation grown around the industrial city of Lacq, France, which has daily emissions of 400 tons SO2 and 150 kg of fluorine, disclosed that in humid and cold years (1961, 1963) plant damage from SO2 predominated while in hot and dry years fluorine damage predominated. While SO2 causes burns immediately upon interaction with plant tissues, necroses produced by HF are slow in developing. Plants were the more susceptible to damage by SO2 the closer external factors came to achieving optimal photosynthetic activity. The sensitivity of luzerne to SO2 doubled when relative humidity was raised from 40 to 100%. Fruit trees manifested enormous differences in sensitivity as did grapevines. While the Petit Mauseign grapevine strain had an SO2 sensitivity threshold of 2.5 ppm, the Tannat strain's threshold was 15 ppm. Fluorine damage is best assessed on apricot trees, which are quite immune to SO2. The sensitivity threshold of plants to fluorine is 10 microg/cu m air. Analyses of sulfur and fluorine levels in plant tissue were of little help in diagnosing the cause of damage, in the case of sulfur because it is a major element of metabolism, and in the case of fluorine because some plants with a high fluorine content do not manifest damage while other plants with low fluorine content do. The various hypotheses of the mechanisms of damage by the two pollutants are discussed.

28477

Garber, Kurt

EXPERIENCE WITH LEAF ANALYSIS IN SMOKE DAMAGE TESTS. (Erfahrungen mit der Blattanalyse bei Rauchschadenuntersuchungen). Text in German. Angew. Botan., vol. 34:33-37, 1960. 3 refs.

The role of chemical analysis in examining plant material for damage caused by smoke is discussed. Most difficult is the diagnosis of SO2 damage, even in case of leaf discoloration, becaus this symptom is not specific. An increased content of sulfur in leaves can be an indication of damage by SO2 but this proof is not reliable, since plants can manifest elevated sulfur levels through intake from the soil. A quantitative micromethod for the detection of SO2 in fresh leaves has been developed by G. Bredemann and H. Radeloff. Hydrochloric acid and chlorine can also be detected by a micromethod (AgNO3) but it is no proof of damage because the natural chloride content in plants fluctuates widely. The same holds for NO2 and NO3. Ammonia can be detected microchemically with great reliability; fluorine can also be detected microchemically and positive tests usually indicate the cause of damage, but the fluorine test is not always reliable. A sensitive and reliable microchemical test also exists for asphalt and tar vapors. Thus, if the circumstances of the damage and local conditions are known, microchemical leaf analysis is useful as an auxiliary method in attributing damage to a specific agent. But leaf analysis by itself does not constitute conclusive proof.

28479

Wentzel, K. F.

SENSITIVITY AND DIFFERENCES IN RESISTANCE OF PLANTS TO POLLUTION. (Empfindlichkeit und Resistenzunterschiede der Pflanzen gegenueber Luftverunreinigung). Text in German. Forstarchiv, 39(9):189-194, Sept. 1968. 27 refs.

Until 1940 the SO2 concentration threshold beyond which damage to vegetation could be expected was considered to be 2 ppm. Recent experiments in chambers with controlled atmosphere show that the true threshold is around 0.2 ppm; and field experiments show that the most sensitive plants manifest deleterious effects from a median long-term exposure level of 0.02 ppm SO2. The sensitivity thresholds for hydrogen fluoride are even lower. These data help explain the wide extent of emmission damage in old coniferous stand as well as the occurrence of such damage at distances 10-30 km from the source. The resistance of plants to pollution varies with a whole complex of factors, primarily with type of emission, growth conditions, the developmental stage of the plants, and nature of the exposure. The combination of these factors will govern the difference in resistance of a plant species. A distinction must be drawn between experimental and field resistance, the former judged by leaf sensitivity, the latter by livability and yield impairment. No sequence of plants can be compiled in their order of resistance that would be valid under all conditions. Generally, the danger to vegetation from pollution increases in the order of cereal crops, deciduous trees, horticultural crops, fruit trees, fodder crops, ornamental plants, and conifers.

28480

Spierings, F.

STUDY OF THE EFFECTS OF FUMES THROUGH FUMIGATION EXPERIMENTS. (Untersuchungen von Raucheinwirkungen durch Begasungsversuche). Text in German. Forschung und Beratung, Reihe C, Wiss. Ber. u. Diskussionsbeitr. (Muenster), vol. 5:56-63, 1963.

Fumigation experiments with controlled atmospheres of hydrogen fluoride and sulfur dioxide involving a number of grasses, plants, bushes, and trees, performed at the Institute voor Plantenziektenkundig Onderzoek in Wageningen (Holland), are described. These experiments were undertaken because of the damage from these pollutants to tulip and gladiolus crops. Experimental results with HF in the case of gladioli were in agreement with observations in the field both as to symptoms of damage and differences in resistance of various strains, but this was not the case with SO2 where laboratory and field results differed. HF was found to cause much greater damage than SO2 and some strains of both tulips and gladioli were found to be more pollution-resistant than others. The concentration range in the experiments for HF was from 0.015 to 0.2 ppm, for SO2 from 0.75 to 3.50 ppm. HF damage in ornamental monocotyledons can be quantitatively expressed by the injury index indicating the percentage length of the leaf rim where damage can be observed. SO2 damage is largely manifested by spots which are not easily measured. The degree of damage was expressed by the color difference between healthy and damaged leave in tomatoes, spinach, and endives, and was determined colorimetrically on alcoholic solutions of leaf pigments. Thus a 6-hr exposure of spinach to 0.5 ppm SO2 resulted in 14% damage, exposure to 1 ppm SO2 in 27% damage.

28483

Baumeister, Walter and Helmut Burghardt

THE PHYSIOLOGICAL EFFECT OF FLUORIDE ON TOMATOES AND SPINACH. (Untersuchungen ueber die physiologische Wirkung von Fluorid bei Tomaten und Spinat). Text in German. Flora (Jena), vol. 144: 213-228, 1956. 23 refs.

The effect of various concentrations of sodium fluoride on tomatoes and spinach was studied under conditions of hydroponic cultivation. The nutrient medium was a solution of 3 salts with Mn, B, Zn, and Fe as additives. In concentrations of 25 and 100 mg F/l for spinac and of 50 and 150 mg F/l for tomatoes, the effect was in all cases deleterious. The weights of the sprouts and roots, apparent CO2 assimilation values, and pigment contents decreased while respiration intensity rose. Leaves yellowed at the tips; their rim dried up or curled up. At the higher concentration levels the plants died after about 4 weeks. At lower concentrations of 1, 5, 10, and 25 mg F/l no effect on apparent CO2 assimilation, respiration, and pigment content was noted. But while in the case of spinach the live weight of the plant was reduced by up to 40%, the weight of tomato plants increased by up to 60% and did not fall off sharply until a 50-mg F/l concentration was reached. In tomatoes the roots, and in spinach the leaves, were most affected. The difference in the reaction of both species may be due to the circumstance that the tomato is free of fluorine while spinach is one of the fluorine-rich plants. Thus, at least on some plants, fluorine seems to have the effect of a trace mineral.

28600

Cormis, L. de

ABSORPTION OF FLUORINE SOLUTIONS AND MIGRATION OF FLUORINE IN THE TOMATO. Ann. Physiol. Veg., 10(3):155-169, 1968. 20 refs. Translated from French. 28p.

Studies were made to determine whether fluorine absorbed by the leaves of tomato plants can be displaced toward the roots and whether the fluorine contained in the soil can be absorbed by the roots and then displaced toward the leaves. In the first part of the study, fluorine was introduced to the aerial parts of tomato plants, either by soaking the leaves or the leaf stalks

with a hydrofluoric acid solution of 4 g/l of fluorine in two tests, the first lasting 2 minutes, the second, 4 minutes. The soaked leaves were rinsed twice in distilled water and their fluorine contents were measured and proved to be, respectively, 319 and 409 ppm, indicating that absorption of the fluorine ion is rapid. In the second part of the experiment, tomato plants were grown in various cultivation environments to which fluorine solutions were added. Tabulated data for both parts of the experiment revealed that fluorine moves normally from the leaf stalk of absorption to the leaflets, the stems serve essentially as a passage area, an appreciable quantity of fluorine is still found in the stem at the time of collection, there is practically no passage of fluorine to the roots, and that if the cultivation environment contains a large quantity of fluorine, the latter is not noticeably displaced toward the leaves even if it is absorbed in small parts of the roots.

28647

Hasegawa, Toshio, Yoshiaki Yamazaki, Hideo Hayashi, and Masaaki Takahashi

ON THE ATMOSPHERIC FLUORIDE POLLUTION. PART III. (Fukkabutsu ni yoru taiki osen chosa. Dai-3-po). Text in Japanese. Taiki Osen Kenkyu (J. Japan Soc. Air Pollution), 5(1):225, 1970. (Proceedings of the Japan Society of Air Pollution, Annual Meeting, 11th, 1970.)

The effects of hydrogen fluoride and sulfur dioxide emitted from a hydrofluoric acid plant in Suita, Osaka Prefecture, were investigated. Samples of the surrounding atmosphere, agricultural crops (rice plants), and soil were analyzed for fluorine and sulfuric acid ions. In addition, the wind speed and wind velocity were measured. Fluorine was analyzed by the alizarine complex method, and sulfuric acid ions by the barium chromate method. The fluorine content of rice plants was 340-379 ppm for those badly damaged, 200-210 ppm for those mildly damaged, and 42-76 ppm for those not damaged at all. The concentrations also tended to decrease with distance from the factory. In soil, the fluorine concentration was 12-38 ppm, and there was not much difference between the polluted and the control areas. The concentration of fluorine at the emission source, measured by dry-type cylindrical filter methods showed 86.2 mg of fluorine/400 sq cm/100 hr. The meteorological data showed that there is a relationship between the frequency of wind direction and the concentration of the pollutants downwind from the emission source.

28679

National Academy of Sciences-National Research Council, Washington, D. C., Subcommittee on Fluorosis Problems

THE FLUOROSIS PROBLEM IN LIVESTOCK PRODUCTION. Pub.- 824, 29p., 1960. 135 refs.

Colored photographs provide definitive diagnostic criteria for determining the incidence and severity of fluorosis in livestock. The development of fluorosis depends on the total fluorine intake, which varies with physiological, phenomena such as growth, heavy lactation, and pregnancy. Sources of fluorine which may affect livestock are mineral feed supplements, water contamination, forage contaminated with soil particles from road dust or as a result of close grazing, forage containing an elevated F content induced by atmospheric fluorines from around industrial plants, and feed concentrates. The tolerance level from a soluble source is 30-50 ppm in the ration for a lactating dairy cow. Rock phosphate fluorine, however, would be tolerated up to 60-100 ppm. Tolerance levels for swine and poultry are higher. The most definitive quantitative measure of the degree of fluorosis is the extent of retention of fluorine in the skeleton. The most sensitive biological reaction to fluoride is that of the developing tooth. Suspected fluorine toxicosis may be diagnosed tentatively by the general health and condition of the herd. Clinical diagnosis supported by chemical analysis can positively identify fluorine toxicosis. The tolerance of an animal to ingested fluorine is increased by consumption of green forage, by supplementing the ration with certain soluble aluminum compounds, by including high levels of calcium in the ration, and by adequate nutrition. Tolerance to fluorine varies with species, and the level tolerated depends upon the form of the fluorine ingested.

28802

Rohmeder, Ernest and Alexander von Schonborn

THE BREEDING OF SPRUCE WITH INCREASED RESISTANCE TO EXHAUST GAS. International Union of Forest Research Organizations, Proc. Congr. Intern. Union Forest Research Organizations, 14th, Munich (West Germany), 1967, 5(Sect. 24):556-566. 8 refs. Translated from German, 12p.

Thirty-six spruce of average age were selected from stands severely damaged by smoke in West Germany; the chosen trees remained somewhat healthy and productive in spite of severe exposure to smoke. About 7000 shoots were obtained by means of grafts from the selected trees. In greenhouse fumigation experiments with exactly measured concentrations of sulfur dioxide and hydrogen fluoride, the grafts displayed considerably more resistance than grafts whose shoots stemmed from spruce living more than 100 years in the high mountains. It was demonstrated that the characteristic of heightened resistance to exhaust gas is based in the genetic spectrum. The resistant grafts were even less damaged by SO2 and HF, and by fumigation mixtures, than were other kinds of conifers and deciduous trees. Only the oak tolerated even higher SO2 and HF concentrations than did the resistant grafts. The greenhouse fumigation experiments clarified which environmental factors influence the smoke resistance of forest trees. It was found that the higher the relative humidity, the higher the light intensity, or the higher the assimilation intensity, the greater the damage to forest trees. During the winter, forest trees contain higher concentrations of components such as SO2 than in the summer. Optimally nourished plants endure higher concentrations than do plants cared for with insufficient nutrients. (Author summary modified)

28830

Huff, Paul B.

DAMAGE TO CITRUS BY FLUORINE AIR POLLUTION IN CENTRAL FLORIDA. Citrus Ind., 40(3):12, 14, 16, 33, March 1959. 1 ref.

In the spring and summer of 1949 a number of groves north of Bartow in Florida began to show tip burning, excessive leaf drop, and a chlorosis in the foliage that was not common to Florida citrus. Then it was noticed that a foggy, pale white, yellow smoke was coming from a new triple-superphosphate plant only about seven-tenths of a mile away. Another such plant went into operation in Polk County, and two citrus groves within three-fourth of a mile South-West of this plant were showing leaf tip burn, leaf drop, and the peculiar chlorotic pattern on the leaves. Losses are indicated. Analysis revealed that fluroine was present in the leaves. As each new triple-superphosphate plant opened and went into operation, the people noticed the native vegetation begin to die. The cattlemen noticed that calves were born too early, and often dead. Liberation of fluorine is discussed, as each ton of raw rock phosphate contains 60 pounds or more of fluorine. An experiment was conducted with Ruby Red Grapefruit trees to prove the cause.

28888

Thomas, Moyer D.

THE INVISIBLE INJURY THEORY OF PLANT DAMAGE. J. Air Pollution Control Assoc., 5(4):205-208, Feb. 1956. 8 refs. (Presented at the Air Pollution Control Association, Annual Meeting, 48th, Detroit, Mich., May 22-26, 1955.)

A summary is presented of the present state of knowledge of sulfur dioxide, hydrogen fluoride, coal smoke, and smog in relation to invisible plant injury. The latter is defined as interference with growth, photosynthesis, respiration, reproduction, or enzymatic function, or demonstratable increase in susceptibility to disease. The evidence relating to physiological activity seems definite that invisible injury due to the reducing conditions that characterize sulfur dioxide fumigations is a second-order effect at the most. No observations have been recorded to suggest that the gas makes plants more susceptible to disease. The oxidizing conditions in smog seem to be more effective in causing invisible injury, possibly because the normal reductive processes in the leaf are less intensive than the oxidative process. Toxic fluoride ions have to be disposed of by rather slow mechanical means like translocation and volatilization and, therefore, permit some invisible injury when threshold concentrations are exceeded. Toxic organic compounds in smoke are more difficult to characterize, because their identity has not been definitely established. Presumably they represent a wide spectrum of compounds which would have to be inactivated primarily by chemical means. They might, therefore, interfere appreciably with the normal reactions in the leaf and cause some invisible injury. (Author summary modified)

28899

Wander, I. W.

EFFECTS OF POLLUTANTS ON VEGETATION (WITH SPECIAL REFERENCE TO THE EFFECT OF FLUORINE ON CITRUS). Fla. Eng. Ind. Expt. Sta. Bull., Eng. Progr. Univ. Florida Bull. Ser., no. 10(9):14-16, Sept. 1956. 20 refs.

Following the construction of several triple-superphosphate manufacturing plants in Polk County, Florida, a unique chlorotic pattern developed on citrus leaves, particularly grapefruit. The condition differed from known chloroses resulting from nutritional deficiencies or toxicities and was eventually traced to the fluorine being released by the phosphate plants. The fluorine content in the chlorotic leaves ranged from 370 ppm to a low of 48 ppm. These findings are noted to contradict a California study which reported no instances of chlorosis in citrus leaves that were found to contain up to 211 ppm fluorine. The fact that chlorosis develops in Florida may be due to the higher humidity under which the leaves mature.

29010

Mohamed, Aly H.

CHROMOSOMAL CHANGES IN MAIZE INDUCED BY HYDROGEN FLUORIDE GAS. Can. J. Genet. Cytol. (Ottawa), 12(3):614-620, Sept. 1970. 18 refs.

Twelve corn plants were placed in growth chambers and fumigated for four to ten days with about 3 micrograms/cu m of hydrogen fluoride (HF). Following treatment, the plants showed no visible symptoms of fluoride injury. However, microsporocyte smears from the plants revealed chromosomal aberrations that included asynaptic regions, translocations, inversions, and bridge plus fragments or fragments by themselves. These abnormalities are considered due to the physiological effect of HF causing chromosome to become sticky and/or to the occurrence of chromatid breakage followed by reunion to form structural changes. These findings indicate that HF is a mutagenic agent. (Author abstract modified)

29206

Brandt, C. Stafford

AMBIENT AIR QUALITY CRITERIA FOR HYDROFLUORINE AND FLUORIDES. VDI (Ver. Duet. Ing.) Ber., no. 164:23-31, 1971. 25 refs.

Air quality criteria (or standards) for fluorine are determined by fluorine's effects on vegetation, animals including man, and physical property. Fluorine's effects on vegetation are the most serious. The uptake of fluorine by plants can result in excess fluorine intake by animals, and cattle are the most sensitive animals. Cattle can tolerate up to 100 ppm of fluorine for up to 30 days. Responses are reduced feed intake, changes in dentition, and fluorine build-up in the skeleton. Knowledge of dietary limits in vegetation is less precise than in the case of animals. Fluorine can cause visible injury and growth effects. Different species have different sensitivities, but generally sensitivity depends on the amount of fluorine content in the tissue. Highly sensitive plants develop symptoms of injury when the tissue level of fluorine is less than 50 ppm. Sensitive plants show injury when fluorine content is 50 to 200 ppm, while tolerant varieties show no symptoms of injury until fluorine exceeds 200 ppm. The relationship between air pollution and fluorine in the soil is debateable, however some correlation exists for the following dose-rate relation: increase in fluoride content of vegetation over normal values expressed in ppm (delta F) equals an atmospheric concentration constant (K) times the average concentration of gaseous fluoride in the atmospher (C) times exposure time in days (T). Vegetation analysis is difficult to translate back to an emission rate of a source. Criteria based on vegetation levels are most useful in defining a goal for an area and confirming that control is or is not adequate.

29277

DAMAGE CAUSED BY FLUORINE NEAR RHEINFELDEN AND MOEHLIN. (Fluorschaeden bei Rheinfelden und Moehlin). Text in German. Leben und Umwelt (Aarau), 12(3):69-71, Dec. 1955.

In 1952 the widespread dying of bees was for the first time attributed to the fluorine in flue gases of the aluminum plant in Rheinfelden-Baden. The bees contained from 5 to 112 mg fluorine in 100 g dry substance while the norm is 0 to 4 mg. In 1953 damage was noted for the first time in vegetation in the form of marbleizing and peripheral damage to leaves. Leaves curled up and assumed a spoon-like shape. More severe damage was manifested by necrosis proceeding from the leaf tip along the rims. Conifers exhibited similar symptoms and some complete defoliation occurred. Especially afflicted were cultures of clover, all cereal crops, and various grasses. The harvest was reduced by 50%. In 1955 cows were afflicted by a peculiar disease; they began to tremble, lost weight, and manifested pain in legs and joints. They often broke ribs and other bones. The fluorine content in cow bones was 6-10 times higher than the norm. These animals, suffering from fluorosis, either recovered spontaneously or died; administration of vitamins did not have any effect. Domestic animals not fed with green fodder or hay were unaffected, as were humans. The milk and meat of the diseased animals did not contain excessive levels of fluorine. Elevated levels of fluorine were detected in vegetation to a distance of 6 km from the factory.

29443

Nakagawa, Yoshihiro, Shozo Matsuda, Masamichi Hara, Tahachiro Koyama, and Nobutaka Takada

CASUALTIES IN PLANTS BY FLUORIDES IN EXHAUSTIVE GAS OF GLAZED TILE MANUFACTURING FACTORY. (Yuyakugawara seizo kojo haigasuchu fukkabutsu ni yoru shokubutsu higai ni tsuite). Text in Japanese. Hyogo-ken Eisei Kenkyusho Kenkyu Hokoku (Rept. Environ. Sci. Inst. Hyogo Prefect.), no. 2:11-17, March 1971. 9 refs.

The cause of crop damage around a glazed tile manufacturing factory was determined by a survey of raw materials, fuel exhaust gas, environmental air, and damaged plants. During the period from May to August 1969, two ceramics with two tunnel kilns (the amount of exhaust gas per one tunnel kiln was 2700 - 2800 N cu m/hr) were tested. The change in fluorides in the tiles by calcination was mersured and 296 - 306 ppm of the fluorides were found before the calcination and 208 - 214 ppm after it. The volatilizing amount of fluorides in the exhaust gas was about 45 ppm. On the other hand, the amount of fluorides contained in the exhaust gas in the fire flue was 1.7 - 4.4 ppm. This was perhaps caused by the condensatio and adhesion of produced fluorides in the remaining heat kiln and i a fire flue. According to the JIS (Japanese Industrial Standard) K 0105 analysis method, the amount of fluorides in the exhaust gas was 0.020 - 0.043 ppm. Also, according to the Lime Treated Filter Paper method by Miller, the highest value in the place where the damage was the most distinctive was 258 micrograms F(-)/100 sq cm/3 days. The damaged plants included carnations, moist-land rice plants and onions. When the fluorides in the leaves were compared with those in healthy leaves, they showed: in carnations, where the amount of fluorides was the highest, the value of the damaged leaves was 52.3 ppm and that of the control leaves was 22.4 ppm; fo the onions, the result was 42.1 ppm in the control leaves and 52.3 ppm for damaged leaves; for bamboo grass growing near the kilns, the amount of the fluorides was more than 12 times that of control leaves. Also, research was made on copper and sulfur oxides, and the obtained value was small in both cases. So the damage to crops is considered to be due to the fluorides.

29597

Nakagawa, Yoshihiro, Shozo Matsuda, Masamichi Hara, Tahachiro Koyama, and Kokei Takada

ON DAMAGE TO PLANTS BY FLUORIDES IN EXHAUST GAS FROM TILE MANUFACTURING FACTORY. (Uwagusurigawara seizo kojo haigasu chu fukkabutsu ni yoru shokubutsu higai ni tsuite). Text in Japanese. Hyogo Prefecture, Kobe (Japan), Environmental Science Inst., Rept. 2, p. 11-16, Feb. 1971. 9 refs.

Crop damage occurred in the limited vicinity of glazed tile manufacturing plants in Hyogo Prefecture. The material clay for the tile contained fluorides, and damage to the carnation and rice plants was chiefly the withering of the leaf tips. Fluorides in the material clay, exhaust gas from the firing kiln, the atmosphere around the factories, and the damaged plants were examined. Fluoride in the material clay was 296-306 ppm. About 30% of the fluoride in the clay volatilized during the baking process. Also, the fluoride in the baked tile was about 208-214 ppm and in the exhaust gas was 1.7-4.4 ppm. Fluoride was 0.020-0.043 ppm in the environmental atmosphere, 52.3-54.3 ppm in the injured carnations and 179.3 ppm in the onions. The metal content in the exhaust gas was also analyzed, since the pigment used with about 80% of the manufactured tiles was copper oxide. The copper volatilizing during the baking process was measured as 10.6-66.8 microg/N cu m. Assuming it becomes diluted to 1 to 200 by atmospheric diffusion (about 200 m away from the source), the density will be about 0.05- 0.34 microg/N cu m, which can hardly affect the plants. Unlike lead, copper does not accumulate in living tissues, so it does not cause chronic poisoning. Total sulfide in the stack gas was estimated at 4.8-5.9 ppm. Taking into account the dilution of sulfide by atmospheric diffusion, the density is too low to adversely affect the plants. Therefore, the primary cause for damage to the plants was fluoride. However, possible geometric or arithmetric effects of various air pollutants may have to be further studied in connection with plant damage.

29616

McCune, Delbert C. and Leonard H. Weinstein

METABOLIC EFFECTS OF ATMOSPHERIC FLUORIDES ON PLANTS. Environ. Pollut., 1(3):169-174, Jan. 1971. 25 refs. (Presented at the Firs International Congress of Plant Pathology, London, England, July 1968.)

The metabolic effects of atmospheric fluorides on plants are reviewed. Studies of enzyme activity in vitro provided most of the information on the nature of fluoride-sensitive sites and the possible mechanism of fluoride inhibition. There are many fluoride-sensitive enzymes; therefore, the possibility of multiple sites of fluoride action exists. Isolated tissues have been used to study the effects of fluoride on metabolic systems in vivo. It has been shown that many metabolic pathways may be affected by fluoride and that the presence or type of effect depends on which pathways are operative. Several metabolic effects are associated with leaf necrosis. The rate of oxygen uptake was increased in beans and gladiolus exposed to hydrogen fluoride. Fluoride-induced inhibitions of O2 uptake have also been reported and the type of effect depended on the age of the plant, duration of exposure, nutrient status, and fluoride concentration. The concentrations or pool sizes of various metabolites are also affected by fluoride. Changes in keto acids, organic acids, amino acids, free sugars, DNA-RNA phosphorus, and starch and non-starch polysaccharides have been found in HF-fumigated plants. The effects of gaseous fluorides on glucose catabolism indicate that the pathways of respiration, monosaccharide interconvension, or polysacchride synthesis are the most likely sites of fluoride activity. The biochemical effects induced by fluoride, not associated with chlorosis or necrosis, are diverse and suggest that many different areas of metabolism can be affected.

29736

Quellmalz, E.

PROBLEMS OF FLUORINE EMISSION MEASUREMENTS. (Problematik der Fluor-Immissionsmessung). Text in German. VDI (Ver. Deut. Ingr.) Ber., no. 164:77-83, 1971.

The correct interpretation of measurements of the fluorine content in air presents some difficulties. The effect of the fluorine can vary depending on the type of compound in which it is present. Biologically, plants are most strongly affected by hydrofluoric acid, animals by free ions of fluorine. In addition to free hydrofluoric acid, other gaseous fluorine compounds can be present in the air, some of which are harmless, whereas others can undergo subsequent reactions and become harmful. It may be assumed that fluorine compounds penetrate the plant surface both in the form of gas and aerosols. The usually ill effects of fluorine compounds in plant food on animals can often be completely neutralized by feeding the animals simultaneously with fodder containing minerals. Emissions of fluorine from industrial sources can have different effects as air pollutants, depending on the industrial process involved. For instance, emissions from blast furnaces containing fluorine carrying dust are more harmless if alkaline sub-

stances, particularly lime, are prevalent in the dust. If acidic substances prevail, the fluorine emissin becomes far more noxious.

29991

Bourbon, P., J. Tournut, J. Alary, J. F. Rouzard, and F. Alengrin

THE EFFECTS OF LOW LEVEL FLUORINE POLLUTION IN A MOUNTAIN VALLEY. (Consequences d une pollution fluoree de faible importance dans une vallee de montagne). Text in French. Tribune Cebedeau, (Centre Belge Etude Doc. Eaux), 24(327):62-66, Feb. 1971. 8 refs.

The effects of fluorine pollution from a phosphoric acid plant discharging daily 20 kg fluorine into the atmosphere of a mountain valley were studied. Ten % of the fluorine was emitted as dust, 25% was contained in aerosol form and in condensation on water and 65% in a gaseous state as SiF4 and HF. In an area of 15.2 sq km, fluorine concentration between 0 and 10 mcg/cu m were recorded over a period of 10 years. Cattle fodder was found to contain between 20 and 50 ppm fluorine contents in the jaws of cattle, signs of dental decay and dental enamel discoloration. This latter symptom was found in cattle living in the polluted zone for 3 years. Occasional lameness was observed in cattle living in the polluted zone for five years and feeding on fodder with a fluorine content of 50 ppm. Exostosis was not observed. While it is difficult to set a fluorine level for fodder which would never cause pathological changes in cattle because of contributory meteorological, ecological, nutritional and physical-chemical factors a maximal permissible level of 20 ppm should be considered a safe level.

30142

Quellmalz, Eberhard and Walter Oelschlaeger

FLUORINE CONCENTRATION OF THE AIR AND PLANTS IN THE VICINITY OF A BRICK KILN. (Fluorgehalte von Luft und Pflanzen in der Umgebung einer Ziegelei). Text in German. Staub, Reinhaltung Luft, 31(5):206-208, May 1971. 11 refs.

Brick kilns emit fluorine in the form of hydrogen fluoride and silicon fluoride. This is particularly true when the crude material contains many fluorine and few alkaline components. Emission measurements were taken with impingers in the vicinity of a brick kiln. In the period from May to August, 49 air samples were taken and the fluorine content was determined. Average concentrations of 1.4 to 6.9 microgram /cu m were determined. In 1968, Bergerghoff units were set up in which gaseous fluorine and fluorine-containing particles were collected. In rural areas the fluorine concentration amounted to 0.1 mg/sq m/day; a maximum concentration of 7.44 mg/sq m/day was found in the vicinity of the brick kiln. Examination of grape leaves revealed that the fluorine concentration rose gradually during the growing season, from 4.2 mg/100 g dry substance on the first of July to 23.5 mg/100 g dry substance on the last day of October. In leave samples from rural areas, the concentration was 1.2 mg/100 g dry substance. In the foliage of peas and string beans, a 10-fold fluorine concentration was found, in spinach a 9-fold, and in lettuce, a 20-fold concentration of that found in the rural areas. No direct correlation between the fluorine content of the leaves and the leaf injuries could be determined.

30225

Weiss, Siegfried

AIR POLLUTION AND THE QUALITY OF WINE. (Luftverunreinigung und Weinqualitaet). Text in German. Muench. Med. Wochenschr. (Munich), 113(23):901, 1971.

Emissions of sulfur dioxide and halogens such as hydrogen chloride, chlorine, fluorine, and hydrogen fluoride stemming from factories and refuse burning produce damage or retarded maturation in grape vines. The maturing fruit is injured by intake of the pollutants through assimilation and through the fine wax layer that coats the berries. The taste of the berries may be spoiled by smoke, mineral oil vapors, asphalt, and tar. Following use of freshly tarred wooden supports for the vine, the taste of tar was transferred through the roots. Dust and soot deposits on the plants also slow the ripening process and impair the taste. Vines within 300 m of highways are polluted by lead. Fortunately, vineyards in Germany are rarely located near highways.

30234

McCune, Delbert C. and Leonard H. Weinstein

METABOLIC EFFECTS OF ATMOSPHERIC FLUORIDES ON PLANTS. Environ. Pollut., no. 1:169-174, 1971. 25 refs.

The metabolic effects of atmospheric fluorides on plants are reviewed. Results of studies on the effect of the pollutant on individual enzymes in vitro, isolated plants or plant parts, enzyme activities, pool sizes of various metabolic intermediates in fumigated plants, or physiological processes such as photosynthesis or respiration in plants exposed to atmospheric fluorides are discussed. Each approach yields important information, but the results must be interpreted in the light of the characteristics and limitations of the systems employed. Fluorides may act as metabolic inhibitors in a process in which the pollutant reacts with a metabolically active site to render it inactive. Presumably this site is in enzyme, although coenzymes or activators may be targets of the pollution. The inhibition of the enzyme results in an inhibition of the reaction mediated by that enzyme. The degree of inhibition depends on the concentration of the inhibitor at the active site, and this in turn depends on the amount and distribution of the inhibitor within the cell. (Author abstract modified)

30297

Scholl, G.

IMMISSION RATE OF FLUORINE IN PLANTS AS A QUANTITATIVE BASIS FOR AN IMMISSION LIMITATION. (Die Immissionsrate von Fluor in Pflanzen als Massstab fuer eine Immissionsbegrenzung). Text in German. VDI (Ver. Deut. Ingr.) Ber., no. 164:39-45, 1971. 16 refs.

The accumulation of fluorine in organs of plants which grow above ground, such as leaves and needles, represents an important criterion for the evaluation of the effect of phytotoxic fluorine compounds on vegetation. The quantity of fluorine absorbed depends on the sensitiveness and absorption capacity of the plants, and on the fluorine concentration in the surrounding air. Fluorine concentrations of less than 0.5 micrograms/cu m air can already cause an accumulation in the course of one growth period of more than 50 mg fluorine in 100 g dry leaf substance. With increasing concentrations of hydrofluoric acid in the air, enrichment of fluorine occurs in tomato leaves, grasses, clover, and other fodder plants. Based on the close connection between fluorine concentrations in the fodder and the fluoric intoxication of cattle, standards of fodder quality are suggested for the protection of domestic animals, particularly cattle and sheep. Since the fluorine content fluctuates with the seasons, a maximum yearly average of 4.0 mg fluorine in 100 g dry substance (DS) based on one analysis per month is proposed, maximum 6.0 mg F/100g DS within two consecutive months, and maximum 8.0 mg f/100 G DS in any individual month. Standardized grass cultures, grown in portable containers under controlled conditions of seed and soil have been developed as measuring devices for

fluorine air polluon. They are being exposed to the open air for 14 days, then washed, dried, and pulverized to obtain the required condition for analysis of the fluor content.

30298

Guderian, R.

FINDINGS FROM GASSING EXPERIMENTS FOR DETERMINATION OF PLANT - DAMAGING HF CONCENTRATIONS. (Ergebnisse aus Begasungsexperimenten zur Ermittlung pflanzenschaedigender HF-Konzentrationen). Text in German. VDI (Ver. Deut. Ingr.) Ber., no. 164:33-37, 1971. 2 refs.

Extensive experiments have been conducted to determine the effect of hydrofluoric acid gas concentrations on plants. The experimental set-up consists of miniature grennhouses in the form of chambers with walls made of plastic sheet, into which rarefied HF-air mixtures are brought from a generating room via plastic piping mounted below ground. Atmospheric air enters through the roofs of the chambers, drawn in by the suction effect of the piped- in mixture. A change of air is thus effected 100 times per hour, and the fluctuations in temperature and humidity inside the chamber follow those of the outer air. The experiments were made with HF concentrations between 0.85 and 25 micrograms/cu m of air. Among the forest cultures, some varieties of fir, spruce, ash, and beech show already after ten days of exposure to average gas concentrations of 1.3 micrograms/cu m of air such distinct damage to needles and leaves that one has to expect drastic retardation of growth in case of exposure for several months or years. The symptoms of damage observed were necrosis on needle tips and blade edges. Fodder plants, particularly varieties of grass and clover, were tested after 16 days exposure to gas of 0.85 and 2.60 micrograms HF/cu m air, respectively. The ensuing enrichment of fluorine in the plants was up to 9 mg F per 100 g dry substance with the weaker HF concentration, and up to 22 mg F per 100 g dry substance with the stronger HF concentration. Visible damage on the clover leaves occurred in the form of chlorosis and in rarer cases necrosis of leaf parts. A table of resistivity of a number o tree, plant, flower, and vegetable varieties to HF effects is shown comprising the very sensitive ones, the sensitive and the less sensitive species. Lasting damage to plants can be caused already by very low HF concentrations in the atmosphere in case of long exposure.

30299

Spierings, F. H. and H. G. Wolting

INFLUENCE OF VERY LOW HF CONCENTRATIONS OF THE LENGTH OF THE DAMAGED BLADE-TIP REGION AND ON THE BULB YIELD WITH THE TULIP VARIETY PARIS . (Der Einfluss sehr niedriger HF-Konzentrationen auf die Laenge der Blattspitzen-Schaedigung und den Zwiebelertrag bei der Tulpenvarietaet Paris). Text in German. VDI (Ver. Deut. Ingr.) Ber., no. 164:19-21, 1971.

In a gardening area outside of Amsterdam, damage to tulips and gladioli by hydrofluoric acid emission from an industrial plant located 8 km away was noted. The same symptoms occurred inside of hothouses where tulips were grown already early in the year. Since HF concentrations inside of hothouses are normally considerably less than in the outside air, long-term tests were made with the tulip variety Paris which was known to be very sensitive. Inside a larger glass building, four specially designed exposure chambers, each of 30 cu m inside volume, were used for these experiments. For producing the noxious mixture of air and HF, air saturated with water vapor was forced through heated hydrofluoric acid, and then combined with a stream of purified outside air. Purification of the latter was effected by filtering for dust removal and passing through shell lime for absorption of gaseous impurities. The mixture thus obtained was equalized in a suspended nylon bag, and then admitted to the four chambers, where a change of atmosphere was taking place three times a minute. The outer air was either sucked in continuously, or alternatively a condition was established where nine tenths of the air was being circulated and one tenth drawn in. The HF concentration in the chambers was checked by sample taking in two three-hour periods each day, using an impinger for subsequent analysis. Graphs of damage to the plants were plotted for conditions of 0.5, 0.7, 1.4, and 4.3 micrograms HF/cu m, with number of weeks of exposure on the abscissa, and damage to blade points in cm on the ordinate. The increase of damage as a function of time was very small at 0.5 micrograms, but became very pronounced at the higher HF concentrations. A study on changes in the yield of bulbs in dependence of HF concentration revealed 100% yield up to 0.3 micrograms HF/cu m, falling off gradually to 55% at 4.0 micrograms HF/cu m air.

30301

Garber, K.

INTRODUCTION AND SURVEY. (Einfuehrung und Ueberblick). Text in German. VDI (Ver. Deut. Ingr.) Ber., no. 164:7-10, 1971. 23 refs.

In 1959, a sub-commission of the Association of German Engineers (Verein Deutscher Ingenieure, VDI) was formed to take care of the preparatory work for establishing guidelines concerning effects and maximum permissible values of fluorine compounds in the air. Since available data at that time were insufficient, an extensive research program was started to reduce the various known methods of fluorine analysis to one or two recognized ones and to clarify important questions in the areas of veterinary medicine and botany. The research work carried out since then yielded many interesting data, for instance relations between fluorine content in the air and the analytically determined F-content of plants. One example of reported figures refers to grass where at average F-content in the air of 1.4 to 1.7 micrograms F/cu m air, the accumulation of F in the grass amounted to 1.5 to 16.6 milligrams/100 g dry grass substance. The results of tests made inside of chambers where plants were exposed to air mixed with hydrofluoric acid under controlled conditions for about 14 days were comparable with open- air observations. The extent of damage to the plants was not only dependent on the F-content in the air, but also on other factors such as humidity, light, temperature, and conditions of growth and nourishment of the plants. An important factor for the absorption of fluorine by plants is rainfall. Measurements made in the vicinity of a phosphate plant showed 10.0 mg F/l of rain water as yearly average in locations in the main wind direction, and in the same location an average accumulation of 185 mg F/100 g dry plant substance. The results from a measuring station located in the opposite direction were 1.85 mg F/l of rain water and 20.5 mg F/100 g dry plant substance.

30368

Fukushima Prefectural Government (Japan), Agricultural Experiment Station

PHOTOGRAPHS FOR ESTIMATING SMOKE INJURY; RICE PLANT. (Engai hantei zuhan). Text in Japanese. 36p. Dec. 1969. 19 refs.

Rice plants at different stages of growth were subjected to high concentrations of sulfur dioxide, hydrogen fluoride (100, 500 ppm), and chlorine (50, 100 ppm) for 30 minutes to study the plant injuries caused by waste gases from chemical factories in the Fukushima Prefecture. Symptoms of plant injury

were shown by colored photographs. Leaf blades showed brown spots after SO2 gas exposure; these spots changed to yellowish-white with increasing gas concentration. Rice plants were sensitive to HF gas and a symptomatic dark greenish-brown coloration, like that of sheath blight disease, was observed in the panicle and leaf tip after exposure to low concentraions. At high concentrations of HF, the leaf blade turned grey and became fragile. Dark brown spots appeared on the leaf blade and leaf sheath following exposure to Cl2. Damage to plant growth occurred with SO2 having the greatest effect and Cl2, the least effect. Damage at different stages of growth occurred in the following decreasing order: young panicle formation period, tillering stage, booting stage, heading stage and milk-ripe stage. The dry weight of the plant also decreased, with HF having the greatest and SO2, the least effect. According to gas exposure, nitrogen and phosphorus increased in absorption rate, potassium and silicon decreased, and calcium, magnesium, iron, and manganese differed according to the stage of growth. However, the amount of nutrient absorption decreased in every case. Tests on lime-emulsion spraying and OED-lime emulsion mixture spraying were also conducted as preventive measures for smoke injury. Spraying which preceded gas fumigation was effective. Lime emulsion-OED mixture was most effective against HF gas and a little less effective against SO2 gas. However, respiratory injury resulted from the spraying and plant growth was inhibited.

30473

Brandt, C. Stafford and Walter W. Heck

EFFECTS OF AIR POLLUTANTS ON VEGETATION. In: Air Pollution. Arthur C. Stern (ed.), Vol. 1, 2nd ed., New York, Academic Press, 1968, Chapt. 12, p. 401-443. 99 refs.

The visible injury symptoms on leaves attributable to air pollution fall within three categories: leaf tissue collapse with necrotic patterns, chlorosis or other color changes, and growth alternations. Continual chronic exposure to low levels of sulfur dioxide will produce a diffuse chlorosis in the leaves of many plants. Continual exposure to ozone causes necrotic lesions through the leaf and eventually collapsed areas. Peroxyacetyl nitrate damage is usually seen as a cross-leaf banding; the typical symptoms can be seen around the edge of the tissue collapse area. Nitrogen dioxide injury develops as bifacial lesions in mature leaf tissue. Fluorides appear to act as cumulative poisons to the lant. When the toxic concentration is reached, the internal cells of the leaf collapse; the result is a characteristic tip and marginal burn, leading to necrosis. Plants sensitive to ethylene may show epinasty, chlorosis, necrosis, leaf abscission, bud abscission, or failure of flowers to open properly. The effects of chlorine, hydrogen sulfide, hydrochloric acid, ammonia, missile propellants, mercury, and herbicides on plants are also given. Factors affecting the response of vegetation to pollutants, such as genetic factors, concentration-time relations, and environmental and growth factors are discussed in detail. The use of plants as pollution indicators has long been accepted. Monitoring programs have included field surveys, bioassay of ambient pollution, and the bioassay of pollutant mixtures produced under laboratory conditions. Injury to plants can be reduced by breeding programs, cultural and management practices, land use, and air quality control.

30805

Suketa, Y., A. Endo, and T. Yamamoto

EFFECT TO AGRICULTURAL CROPS BY AMBIENT FLUORIDES. (Kichu fukkabutsu no kankyo nodo to nosakubtusu e no elkyo). Text in Japanese. Taiki Osen Kenkyu (J. Japan Soc. Air Pollution), 5(1):159, 1970. (Proceedings of the Japan Society of Air Pollution, Annual Meeting, 11th, Tokyo, Japan, 1970.)

The relationship between the fluoride concentration in the atmosphere and the distance from the source was examined. The atmosphere at polluted area A, 0.5 km from the emission source, contained an average of 10 F (counting the F of unpolluted area as one). The F in dust particles varied from 0.49 to 3.25 micrograms/cu m, and showed the highest concentration at the distance of 1.0 km from the emission souce. One-year old orange leaves at area A showed 227.0 ppm F content, and two-year old leaves had 571.3 ppm F. One-year old leaves had 165.7 to 203.3 ppm F at the distance 1.0 to 3.5 km from the emission source, and two-year old leaves had 365.3 to 391.0 ppm. The F in the air captured by alkali filter paper decreased in proportion to the distance, but the ratio did not coincide with that of F content in leaves and the distance, which seemed to signify an effect of F on metabolism. The F content and visual damage on taro potatoes was compared in area B in 1969 and 1970. Leaves with visible damage 0.5 km from the emission source contained 74.4 ppm and 69.4 ppm F, and those with no visible effect had 40.9 ppm. This contrasted with the F content in the plants in the control areas (distances of 10 km or more) which varied from 9.4 to 18.9 ppm.

30806

Takahashi, R. , Y. Suketa, and T. Yamamoto

EFFECT OF ATMOSPHERIC FLUORIDE ON PLANT METABOLISM. (Kichu fukkabutsu ni yoru shokubutsu taisha e no elkyo). Text in Japanese. Taiki Osen Kenkyu (J. Japan Soc. Air Pollution), 5(1):160, 1970. (Proceedings of the Japan Society of Air Pollution, Annual Meeting, 11th, Tokyo, Japan, 1970.)

The influence of fluoride on glycolysis phosphoric acid enzyme of gladiolus, especially on beta glycero-phosphatase action was observed. Bulbs of glaioli were cultured for three weeks in Hoagland culture solution. They were then exposed to HF of a given concentration and temperature in fumigation chambers for one, five, and 10 days. Changes in beta glycerophosphatase action, protein content, chlorophyll content, and appearance of the leaves were observed. The glycero-phosphatase actions in the gladiolus leaves exposed in HF 11.7 micrograms/cu m and 20.9 micrograms/cu m were both lower than those of the control plants. The leaves affected by 20.9 micrograms HF functioned at 55% of the normal activity. Tests also revealed that gladiolus was much more susceptible to HF damage than crocus or iris. The protein content of the leaves and bulbs of gladiolus exposed to 20.9 micrograms/cu m HF showed a 42.5% decrease. Chlorophyll content in the leaves at 11.7 micrograms/cu m was 88% of that in the control plants. It decreased further to 69% in 20.9 micrograms. A significant effect of atmospheric f on plant metabolism was deduced.

31124

Suketa, Yasunobu and Takeo Yamamoto

EFFECT OF ATMOSPHERIC FLUORIDE ON PLANT METABOLISM. (Kichu fukkabutsu no shokubutsu daisha e no elkyo). Text in Japanese. Kogai to Taisaku (J. Pollution Control), 7(5):427-434, May 1971. 30 refs.

Leaf scorch, or foliar burn, is a common symptom of plant injury caused by atmospheric fluoride. Chlorosis is another symptom of fluoride injury. The density is atmospheric fluoride and its accumulation in a living plant, the effect of fluoride on plant metabolism, and the hereditary effect of the fluoride on plants are discussed. Studies on the relationship

between the exposure factor and foliar deposition of the fluoride, or foliar burn, was introduced briefly. The value of the exposure factor is about the same for cases of both the high concentration (890 micrograms/cu m) and low concentration (40 micrograms/cu m). It also shows a similar distribution of the fluoride deposition, in high or low concentration, if the exposure factor gives the same value. Photosynthesis is adversely affected by the atmospheric fluoride. The photosynthesis of a strawberry deteriorated by 50% when the strawberry was exposed to 48 ppb hydrofluoric acid for one hour. The effect of fluoride on the respiratory organs of plants was also reported. Soy beans exposed to 0.03 ppm HF had metabolic abnormalities. The total sugar quantity of its leaves decreased from 242-253 mg/100 g to 111-141 mg/100 g and the non-reduced sugar/reduced sugar ratio decreased from 4.6-8.7 to 0.8-1.6. For the hereditary effect of fluoride on plants, is also discussed.

31208

Oelschlaeger, W.

FLUORIDE IN FOOD. Fluoride, 3(1):6-11, Jan. 1970. 4 refs.

The results of fluoride assays in food, in the vicinity of fluoride--emitting factories and under normal conditions, are presented. Lettuce and spinach contain more fluoride than other vegetables; sweet cherries more than other fruits. In peas, 200 times more fluoride was found in polished than in unpolished peas. The fluoride content of polished rice was 50 times higher than that of unpolished rice. Food derived from animals was higher in fluoride than that which originated from plants. The largest amounts were found in fish. A person eating an average daily diet would consume between 0.3 and 0.4 mg of fluoride. The addition of polished peas and rice, tea, and fish may raise the daily average intake to above two milligrams. Foods from areas near fluoride-emitting factories has much higher fluoride levels than the uncontaminated areas. Near a hydrofluoric acid factory, milk contained 5.7 ppm, compared with 0.05 ppm fluoride in non-contaminated areas.

31448

Pack, Merrill R.

RESPONSE OF STRAWBERRY FRUITING TO HYDROGEN FLUORIDE FUMIGATION. Preprint, Air Pollution Control Assoc., Pittsburgh, Pa., 16p., 1971. 12 refs. (Presented at the Air Pollution Control Association Annual Meeting, 64th, Atlantic City, N. J., June 27- July 2, 1971, Paper 71-102.)

Strawberry plants were grown throughout flowering and fruiting under continuous, long-term exposure to hydrogen fluoride gas at fairly uniform concentrations averaging 0.55, 2.0, 5.0, and 10.4 micrograms/cu m. At 0.55 micrograms fluoride/cu m, there was a small but significant increase in fruit deformation, predominantly at the apical end of the fruit, which was associated with lack of development of some seeds and the adjacent receptacle tissue. In the higher HF treatments, deformities were proportionately more prevalent and severe. At 2.0 micrograms F/cu m and higher, the average fruit weights were also significantly lower than in the control atmosphere; and at 5.0 and 10.4 micrograms F/cu m, the proportion of the flowers that developed into fruit was smaller. None of the HF treatments significantly influenced the number of flowers produced. There were no fluoride injury symptoms on the foliage at 0.55 micrograms F/cu m and only very mild, uncertain symptoms at 2.0 micrograms F/cu m. Therefore, the effects of HF on strawberry fruiting seemed to be independent of visible injury to the foliage and to result from inhibition of seed development. (Author abstract modified)

31527

Hill, A. Clyde

VEGETATION: A SINK FOR ATMOSPHERIC POLLUTANTS. Preprint, Air Pollution Control Assoc., Pittsburgh, Pa., 37p., 1971. 26 refs. (Presented at the Air Pollution Control Association, Annual Meeting, 64th, Atlantic City, N. J., June 27-July 2, 1971, Paper 71-66.)

The possibility of vegetation being an important sink for gaseous air pollutants was investigated. Plant pollutant uptake measurements were made utilizing a typical vegetation canopy and chambers that were designed specifically for gaseous exchange studies. An alfalfa canopy was indicated to remove gases from the atmosphere in the following descending order: hydrogen fluoride, sulfur dioxide, chlorine, nitrogen dioxide, ozone, peroxyacetyl nitrate, nitric oxide, and carbon monoxide. The absorption rate of NO was low, and no absorption of CO could be detected by the methods used. In the typical ambient concentration range, uptake increased linearly with increasing concentration except for O3 and Cl2 which caused partial stomatal closure at the higher concentrations. Wind velocity above the plants, height of the canopy, and light intensity were shown to affect the pollutant removal rate. A relationship between the absorption rate and solubility of the pollutant in water was also shown. (Author abstract)

31733

Daessler, Hans-Guenther and Hans Grumbach

WASTE-GAS DAMAGE TO FRUIT IN THE VICINITY OF A FLUORINE PLANT. Arch. Pflanzenschutz, 3(1):59-69, 1967. 10 refs. Translated from German. Sanzare Assoc., Inc., Philadelphia, Pa., 14p.

The effects of fluorine emissions on certain species and varieties of fruits are described. During periods of high humidity, slowly moving emission clouds form to cause acute damage with severe leaf necrosis. High pressure weather conditions lead to chronic damage which becomes apparent during harvest time. The behavior of vegetation to fluorine emissions depends, to a large degree, upon what stage the vegetation is in and its physiological activity. Signs of fluorine damage on sweet cherries, plums, apples, and pears are described. The resistivity of plants can be influenced by the application of certain hormones and by spraying the plants with lime to reduce the sensitivity to hydrogen fluoride.

32280

Raay, A. van

THE USE OF INDICATOR PLANTS TO ESTIMATE AIR POLLUTION BY SO2 AND HF. Council of Europe, Committee of Experts on Air Pollution, Air Pollution Proc. First European Congr. Influence Air Pollution Plants Animals, Wageningen, Netherlands, 1968, p. 319-328. (April 22-27.)

Indicator plants can be used to estimate damage to crops by air pollution, although they can never give an absolute measure. An indicator plant must be sensitive to a certain contaminant, and it must react with clearly visible specific symptoms, preferably at low concentrations. Sulfur dioxide and hydrogen fluoride pollution may be detected with plants that accumulate the contaminant or with simple measuring devices. Both symptoms and chemical analysis must be used to trace the source, the rate, and the extent of contamination. Indicator plants with a different reaction to SO2 and HF allow distinction in areas where both pollutants occur. Endive, lucerne, clover, buckwheat, and barley may be used to detect SO2, and gladioli and freesias for HF. By using these plants in many small plots it is possible to mark the polluted area. The advantages of this method are low cost and immediate and easy

indication of the pollution. The disadvantages are the possible non-specificity of symptoms and losses of the pollutant from the plant. Gladioli are being studied for a possible correlation between the fluorine content of leaves, or tipburn injury, and the fluorine concentration of exposed sticky papers. (Author abstract modified)

32282

Spierings, F. H. F. G.

A SPECIAL TYPE OF LEAF INJURY CAUSED BY HYDROGEN FLUORIDE FUMIGATION OF NARCISSUS AND NERINE. Council of Europe, Committee of Experts on Air Pollution, Air Pollution Proc. First European Congr. Influence Air Pollution Plants Animals, Wageningen, Netherlands, 1968, p. 87-89. (April 22-27.)

The studies of injuries to monocotyledonous ornamental flowers growing near a steel factory west of Amsterdam, gladioli and tulips artificially fumigated with hydrogen fluoride showed the same order of sensitivity as in the field. Tests in a fumigation chamber with different concentrations of HF resulted in the following order of decreasing sensitivity: Ixia, Freesia, Crocus, Sparaxis, Fritillaria, Chionodoxa, Scilla, Muscari, and Galanthus. The symptoms of injury were an ivory-colored necrosis of leaf tips, or, in freesias, a marginal ivory-colored necrosis. Narcissus and Nerine bowdenii showed different symptoms; after the appearance of the ivroy-colored leaf tip, the injured part of the leaf slowly extended and a yellow discoloration started clore to the original necrosis. This area may stretch several times further than the injured tip. (Author abstract modified)

32286

Robak, H.

ALUMINIUM PLANTS AND CONIFERS IN NORWAY. Council of Europe, Committee of Experts on Air Pollution, Air Pollution Proc. First European Congr. Influence Air Pollution Plants Animals, Wageningen, Netherlands, 1968, p. 27-31. (April 22-27.)

Quantities of fluorine emitted from aluminum plants polluting the air in Norway vary from 8-10 to 27-30 kg/hr. Natural pine forests in the neighborhood of all plants are notably damaged, in three cases even completely destroyed. Visible injury is observable at up to 32 km. The current year s needles of badly damaged trees usually show a fluorine content above 40 ppm. Damage to spruce forests has occurred in a 100-200 ha area within which the fluorine content of the current year s needles exceeds 15-20 ppm and that of the last year s needles 24-35 ppm. Because the outlook for preventing fluorine-induced conifer damage by technical means does not appear promising, a switch should be made to more resistant conifer species. Field observations and experimental plot studies show that Larix decidua and L. leptolepis are remarkably free from damage, even under unfavorable weather conditions.

32289

Ender, F.

THE EFFECTS OF AIR POLLUTION ON ANIMALS. Council of Europe, Committee of Experts on Air Pollution, Air Pollution Proc. First European Congr. Influence Air Pollution Plants Animals, Wageningen, Netherlands, 1968, p. 245-254. 12 refs. (April 22-27.)

The most important problem concerning damage to animals by air pollution is the poisoning of domestic animals by fluorine in smoke, gas, or dust from various industries. The extent of the problem is illustrated by evidence from the international literature and studies conducted in Norway, where the postwar growth in aluminum production has produced a tremendous rise in livestock fluorosis. The total quantity of fluorine in gases emitted by an aluminum plant is roughly 20 kg/ton of aluminum produced. Emitted with the smoke and other damaging compounds such as gaseous hydrofluoric acid and fluosilicic acid, dust-containing cryolite, and aluminum- and calcium-containing fluorides. The geographic location as well as topographic conditions near the aluminum factories have a striking influence on the fluorine contamination of soil and vegetation in the surroundings. The risk of fluorine injuries in neighboring valley districts is far greater with factories located at the bottom of deep, narrow, U-shaped valleys than with those on open, unsheltered ground. Despite installation of gas purification procedures, it is impossible to completely prevent the escape of fluorine-containing gases from doors, ducts, and windows in electrolysis halls. With respect to the defluorination of forage, good results have been obtained by treating contaminated grass with a mixture of diluted sulfuric acid and hydrochloric acid, or by using formic acid.

32291

Stamatovic, S. and D. Milic

PROBLEMS OF AIR POLLUTION IN YUGOSLAVIA. Council of Europe, Committee of Experts on Air Pollution, Air Pollution Proc. First European Congr. Influence Air Pollution Plants Animals, Wageningen, Netherlands, 1968, p. 255-258. (April 22-27.)

The expansion of the nitrogen and phosphate fertilizer industries in Yugoslavia has caused an increase in fluor emissions, endangering plants and domestic animals. In affected areas, fluorosis has been observed in horses, cattle, sheep, and goats. Its occurrence is explained by the quantities of fluor measured in hay, straw, wheat, maize, and sunflower seeds. The intensity of the poisoning varies according to geographic location, climate, and animal species. Under normal conditions, damages are restricted to a distance of about 5 km from the factories. A lead foundry has created the problem of lead accumulation in soil, water, and animals, particularly in ruminants. Lead poisoning has been observed in lambs but so far not in sheep. Sheep milk in the affected area contains an average of 132 gamma/100 g lead. About the same concentration is found in milk from cows, though no lead poisoning has been observed in cattle.

32334

Donaubauer, Edwin

SECONDARY DAMAGE IN REGIONS OF AUSTRIA EXPOSED TO POLLUTION. DIFFICULTIES IN DIAGNOSIS AND ASSESSMENT. (Sekundaerschaeden in Oesterreichischen Rauschschadengebieten. Schwierigkeiten der Diagnose und Bewertung). Text in German. Polska Akademia Nauk, Zaklad Badan Naukowych Gornoslaskiego Okrega Przemyslowego, Mater. Miedzynarodowej Konf., Wplyw Zanieczyszczen Powietrza na Lasy, 6th, Katowice, Poland, 1968, p. 277-284. 10 refs. (Sept. 9-14.)

Secondary damage from pollution most frequently occurs through sunburn on peripheral susceptible tree stands in clearings of wooded areas. Such trees, damaged by the sun, attract pests and die. This applies especially to pine stands. In the pollution- exposed areas of Aichfeld near Judenburg and Gailitz-Arnoldstein, needles of mature pine stands suddenly turned brown in 1963 following the appearance of an additional pollutant (hydrofluoric acid) into the already sulfur dioxide-polluted atmosphere (first area) and intensification of SO2 emission (second area). A contributing factor was an ex-

ceedingly cold winter with temperatures 4 to 5 C below the long-term average. Pollution- exposed stands are more susceptible to infestation with the fungus Armillaria mellea which causes great damage in Austria to pine, spruce, and deciduous tree stands. Other pests which proliferate in pollution-damaged stands are Pissodes piceae, Cryphalus piceae, Ips typographus, and Pissodes harcyniae. Generally it is not easy to prove a causal relationship between emission and secondary damge: detection of damage in a pollution-exposed area is not sufficient proof. The task is easier where identical or similar stands in unpolluted areas are available for comparison.

32339

Szalonek, Irena

FLUORINE-INDUCED POLLUTION AND PLANT DAMAGE IN THE VICINITY OF A METAL ENAMELING PLANT. (Die durch Fluor hervorgerufene Luftverunreinigung und die Pflanzenbeschaedigung in der Naehe eines Emaillierwerkes). Text in German. Polska Akademia Nauk, Zaklad Badan Naukowych Gornoslaskiego Okregu Przemyslowego, Mater. Miedzynarodowej Konf., Wplyw Zanieczyszczen Powietrza na Lasy, 6th, Katowice, Poland, 1968, p. 117-125. 4 refs. (Sept. 9-14.)

Fluorine-induced damage observed on fruit trees and garden plants at distances of 200-500 m from a metal enameling plant initiated measurements of fluorine emission at 0.5 and 2.5-3 m above ground and of fluorine content in plant life. The tests were performed by exposing filter paper saturated with calcium hydroxide to the atmosphere for 3.5 and 10 hours and for 30 days respectively from October 1967 to February 1968. Leaves were completely destroyed on 10-year old five-m high fruit trees, and of peripheral leaf necrosis and light grey to brown spots occurred on ornamental plants and Phaseolus vulgaris. The median monthly atmospheric fluorine level in the area of greatest damage (200 m from source) was 2.649 mg F/100 sq m with a maximum of 3.029 mg F/100 sq m at 2.5 m above ground and 2.004 mg F/100 sq m at 0.5 m above ground. The pollution level at 2.5 m above ground was everywhere greater than at 0.5 m above ground. The fluorine content in leaves of bean plants at 1.5 to 2 m above ground was 285 m from the source, two to three times that of plants growing close to the ground. Fruit trees were more susceptible to damage than horticultural and crop cultures.

32343

Kisser, Josef

THE PHYSIOLOGIC EFFECT OF POLLUTION ON VEGETATION. (Physiologische Probleme der Einwirkung von Luftverunreinigungen auf die Vegetation). Text in German. Polska Akademia Nauk, Zaklad Badan Naukowych Gornoslaskiego Okregu Przemyslowego, Mater. Miedzynarodowej Konf., Wplyw Zanieczyszczen Powietrza na Lasy, 6th, Katowice, Poland, 1968, p. 27-43. 18 refs. (Sept. 9-14.)

The observations that individual plants in a monoculture react differently to air pollution, that gladioli strains differ in their resistance to pollutants, and that resistance of a plant to hydrofluoric acid does not coincide with its resistance to sulfur dioxide lead to the conclusion that generally there are no pollution resistant plants or strains but only increased resistance to a certain chemical compound. The major part of damage to vegetation can be attributed to gaseous components of smoke emissions which penetrate into leaf tissues by gas diffusion. The degree of damage to leaf cells depends basically on the quantity of gas that penetrates into the leaf tissues and on peak concentrations, if the leaf pores are open during the emission period. Exposure of plants to hydrochloric acid caused a depression of the water balance while exposure to SO2 caused an initial rise, indicating that the effect on the pore opening mechanism can differ from gas to gas. Higher osmotic pressures and greater diffusion in peripheral regions and leaf tips were found in all plants examined, where leaf damage is initially manifested. In some cases the distribution of leaf damage is also determined by leaf veins.

32344

Jung, Erwin

CHANGES IN AFFORESTATION OF THE POLLUTED REGION OF RAUSHOFEN. (Bestandesumwandlungen im Rauchschadengebiete von Raushofen). Text in German. Polska Akademia Nauk, Zaklad Badan Naukowych Gornoslaskiego Okregu Przemyslowego, Mater. Miedzynarodowej Konf., Wplyw Zanieczyszczen Powietrza na Lasy, 6th, Katowice, Poland, 1968, p. 407-413. (Sept. 9-14.)

An aluminum plant in Raushofen is the source of fluorine and tar containing emissions polluting 800 ha of an almost entirely wooded countryside of spruce and white pine with some fir and beech trees. Of this area 120 ha were either completely destroyed by pollution or so heavily damaged that reforestation with more resistant species became necessary. Sixty ha were planted with birches and alders 5 to 6 m high; while they are not a crop-yielding culture they form, because of their high resistance to heavy concentrations of pollutants, and excellent protective belt around the aluminum plant. Only in the close vicinity of the ovens did the alder not take hold. There, sallow (Salix caprea) was planted which, while only 1.5 to 2 m high, does contain the heaviest pollution emitted from the ovens. The alder belt is about 600 m deep. The remaining 60 ha furthest from the plant were replanted with larch trees. Two ha were planted experimentally with fir. Parcels of the remaining woods were classified according to a five-point scale with the fifth point denoting the highest degree of pollution damage. Reforestation is ordered when a parcel incurs 40% damage (2.5 on the point scale).

32516

Knabe, Wilhelm and Karl-Heinz Guenther

CONTRIBUTIONS OF FORESTRY TO THE ENVIRONMENTAL PROTECTION IN NORTH RHINE WESTPHALIA. (Forstwissenschaftliche Beitraege zum Umweltschutz in Nordrhein-Westfalen). Text in German. Allg. Forstz., 26(24):503-506, 513-514, June 1971. 28 refs.

The contribution of forestry to environmental protection consists primarily of observations of the effects of air pollutants on trees and plants. The results from indoor exposure test (in greenhouses) do not always reflect the true situation. In open air exposure experiments, young spruce trees grown from seeds were less resistant than scions, whose needles had all the characteristics of those of an old tree. In outdoor gasification experiments, spruces, set up at different levels above the ground, were exposed to the emissions from an aluminum plant. The higher elevated plants were exposed to more fluorine because of greater air ventilation. Tall old trees were injured while young ones growing next to them were seemingly healthy. Although more fluorine was absorbed by the plants, it was eliminated again after some time. In North Rhine Westphalia, forests with an average sulfur dioxide concentration of more than 0.08 mg/cu m during the growing season over three quarters of all measurement years were unsuitable for the growth of any coniferous trees with the exception of Pinus nigra Arn.

32535

Bovay, E. and R. Zuber

NECROSES ON APRICOTS: GASING EXPERIMENTS WITH HYDROFLUORIC ACID. (Necroses sur abricots: essais de gazage au moyen d acide fluorhydrique). Text in French. Revue Suisse de Viticulture et Arboriculture (Lausanne), 3(3):78-81, May-June 1971.

Necroses on apricots were frequently observed in the alpine valleys where certain chemical and metallurgical industries, particularly aluminum factories, were emitting fluorine into the atmosphere. Gasing experiments were conducted with various concentrations of hydrofluoric acid on apricot trees and picked fruit. Meteorological conditions of temperature, humidity, and precipitation were observed. Exposure to hydrofluoric acid caused necroses to appear on the leaves and the apricots similar to the necroses on the fruits affected by industrial fluorine emissions. A dry climate, high temperature, fine precipitation followed by long periods of sunny weather, followed in turn by more dry spells were favorably correlated to the appearance of necroses.

32536

Bolay, A., E. Bovay, G. Neury, J. P. Quinche, and R. Zuber

DAMAGE TO APRICOTS AND OTHER FRUITS CAUSED BY FLUORINE COMPOUNDS. (Degats causes aux abricots et a d autres fruits par les composes fluores). Text in French. Revue Suisse de Viticulture et Arboriculture (Lausanne), 3(3):82-92, May-June 1971. 49 refs.

Stone fruits (apricots, peaches, plums, and cherries), pears, and apples grown in the alpine valley (Valais, South Tirol, and Savoy) were examined for fluorine-induced damages. Climatic conditions, particularly temperature, humidity, and precipitation, were observed and correlated. Symptoms of fluorosis on the stone fruits were characterized by well-delimited brown-black necroses, sometimes surrounded by a reddish aureole. The necroses were deep and reached to the stone on very young fruits and were rather superficial on fruits approaching maturity, which were most sensitive to fluorine. Pears gave similar results. Fluorosis on apples appeared as a reddening of the epidermis and rifts appearing around the apex or on the most exposed side. The apples were deformed. Damage symptoms were identical regardless of the origin of the fluorine: atmospheric pollution, fluorine salts sprayed on the fruit, or absorption by the roots from fertilizers containing fluoborate compounds.

32539

Bolay, A., E. Bovay, J.-P. Quinche, and R. Zuber

AMOUNTS OF FLUORINE AND BORON IN THE LEAVES AND FRUITS OF FRUIT TREES AND VINEYARDS, FERTILIZED BY CERTAIN BORON- AND FLUORINE-CONTAINING FERTILIZERS. (Teneurs en fluor et en bore des feuilles et des fruits d arbres fruitiers et de vignes, fumes avec certains engrais composes, boriques fluores). Text in French. Revue Suisse de Viticulture et Arboriculture (Lausanne), 3(3):54-61, May-June 1971. 14 refs.

Various orchards and vineyards were examined for absorption of fluorine and boron from the atmosphere and certain fertilizers by the fruits and leaves. Apricot trees grown in the orchards of Rechy were affected by fluorine emissions from certain aluminum factories. The amount of fluorine in the leaves was proportional to the age, regardless of the fertilizer. Young leaves, that emerged in the hot summer months, were most damaged by the fluorine emissions but contained the least fluorine. Conversely, the youngest leaves were richest in boron content. Apricot orchards in Bieudron and Fey, areas of minimal air pollution, had very few appearances of necroses. The fluorine content in the leaves remained in the range of 17-28 ppm. A stronger application of fertilizer increased the fluorine content but had no notable effect on the boron content or chemical composition of the apricots. Comparable results were gathered in one of the apricot orchards in Martigny. The other, exposed to fluorine emitted by an aluminum factory, had a higher fluorine content in the leaves. The treatment of apricot trees by a fungicide containing fluorine had no effect on the fluorine content. The boron content was clearly increased upon application of the boron-containing fertilizer, but the fruits did not absorb the fluorine of the fertilizer. Tests on orchards in Marcelin and Changins, areas virtually free of fluorine in the atmosphere, determined an increase in fluorine content in the leaves and of necroses due to the fertilizer. Plum and pear trees examined under similar conditions gave comparable results, with slight variations for different variables of pollution and fertilizer. Vineyards were also tested in Valais. General results indicated that the combined boron-containing fertilizers determined an evident accumulation of fluorine in the leaves of the plants but had no effect on the fluorine content in the fruits, which was proportional to the degree of pollution by industrial fluorine emissions in the atmosphere.

32588

Dziubek, Tadeusz

HARMFUL INFLUENCE OF INDUSTRIAL DUSTS UPON PLANTS AND ANIMAL ORGANISMS. (O ujemnych skutkach pylow fabrycznych na roslinnosc i organizmy zwierzece). Text in Polish. Zesz. Probl. Postepow Nauk Rolnicych (Warsaw), no. 74:195-197, 1967.

Contamination of the atmosphere near aluminum and copper foundries and phosphate fertilizer plants is caused mainly by fluorine compounds. The contamination damages plants, meadows, and pastures adjacent to factories or situated in the vicinity and has an indirect effect on domestic animals fed with fodder from such grasslands. Grassland vegetation 100-3000 m from the factories were investigated by measuring the quality and quantity of dust; 0-30 mg% fluorine compounds were found. Changes in cattle tissue (teeth and bones), a decrease in lactation, and a stunting of young animal growth were noted. A considerable decrease in the hemoglobin in the animals investigated also occurred.

32672

Feriancova-Masarova, Zora and Eva Kalivodova

THE EFFECT OF EXHALATIONS FROM THE ALUMINUM PLANT IN ZIAR N/HRONOM ON THE SPECTRUM OF BIRD SPECIES IN THE VICINITY OF THE PLANT. (Vplyv exhalatov hlinikarne v Ziari nad Hronom na druhove zlozenie vtakov v okoli). Text in Slovak. Biologia (Bratislava), 20(2):109-121, 1965. 28 refs.

Composition of the bird population composition was studied for three years in five biotopes (woods, orchards, fields, streams, and villages) situated in three geographic zones contaminated with varying fluorine concentrations and in one uncontaminated zone. The zones formed concentric belts around an aluminum plant. Severe fluorine damage to conifers, fruit trees, and various deciduous species caused a change in the biotopes which in turn affected the nesting habits of birds. These changes were significant in the wooded area villages, in the other biotopes the changes seemed unrelated to fluorine levels. The number of bird species nesting in woods (first biotope) was 8, 6, 17, and 22 respectively in the four zones;

the number of transient bird species in the respective zones was 15, 8, 7, and 9. These counts indicate that the number of nesting species was lowest in the zone with the maximal fluorine level. The same result was obtained when the numbers of nesting species in the four zones were compared without regard to biotope. Thus a shift of nesting species away from the source of pollution is in progress.

32673

Kostolanska, Anna and Evgen Hluchan

THE EFFECT OF EXHALATIONS FROM AN ALUMINUM PLANT ON THE FLUORIDE CONTENT IN BONES OF FROGS. (Vplyv exhalatov z hlinikarne na obsah fluoridov v kostiach ziab). Text in Slovak. Biologia (Bratislava), 20(12):916-919, 1965. 5 refs.

The effect of emissions from an aluminum plant on the calcium fluoride content in bones of R. temporaria, R. dalmatina, and R. esculenta living in the vicinity of the plant was determined and compared with respective fluoride contents in uncontaminated frogs. The fluoride levels found in 100 g dry bones fluctuated between 51.5 and 488.4 mg F compared with 21.6 and 69.6 mg F in uncontaminated frogs, a tenfold increase in fluoride content. Stagnant water near the plant contained 10.9 mg F/liter. Surface soil samples contained 91 mg F/100 g soil. The high fluorine content caused reduction of the phosphorus content in frog bones.

32714

Monden, Masaya, Yuzuru Yumiba, and Akira Tanaka

PLANT DAMAGE BY AIR POLLUTION. (Taiki osen ni yoru shokubutsu higai). Text in Japanese. Anzen Kogaku (J. Japan Soc. Safety Eng.), 10(4):189-196, Aug. 1971. 2 refs.

Plants were exposed to sulfur dioxide, chlorine (hydrogen chloride), fluorine (hydrogen fluoride), zone, peroxyacetyl nitrate (PAN), and nitrogen oxides (nitric oxide and nitrogen dioxide) and observed for symptoms of plant damage. The effects of exposure to sea winds, frost, and SO2 appeared as round spots around the leaf edge or between the leaf veins. The spots increased with strong sunlight. Damage due to HCl, large irregularly shaped spots, was limited to small areas of the leeward side, but was sometimes severe. Symptoms of damage by HF were similar to those of Cl2; the damage and healthy parts of the plant were clearly distinct with HF damage. Apricot trees and gladiolus were very sensitive to HF exposure and effected by concentrations of 0.1 ppb and less. The HF content of the damaged leaf attained 50%. Damage due to ozone, caused by factory and automotive exhaust gases, was most severe in June and July. Among the nitrogen oxides, NO2 and NO caused most damage and inhibited plant growth. PAN, the product of a photochemical reaction, caused reduction of the photosynthetic function when damage was chronic; in cases of acute damage, it affected the protoplasm and produced cavity formations on leaves.

32736

Schmitt, Nicholas, Gordon Brown, E. Larry Devlin, Anthony A. Larsen, E. Douglas McCausland, and J. Maxwell Saville

LEAD POISONING IN HORSES. Arch. Environ. Health, vol. 23:185-197, Sept. 1971. 13 refs.

Five elements (lead, zinc, fluorine, arsenic, and cadmium) were investigated in the vicinity of a smelter; excessive amounts of lead in ingested forage were considered to be the primary cause of a chronic debilitating disorder in six horses. The high lead levels in forage were related to the presence of lead in surface soil accumulated from emissions of a nearby smelter. Young horses were found to have a significantly higher susceptibility to the effects of lead than older horses and cattle. The role played by high concentrations of zinc in local grasses is not fully understood. The possibility of a synergistic effect of zinc and other trace elements on animal health deserves further study. While elevated fluoride content in some of the grasses tested was evident, fluorosis was ruled out as a cause of illness in the affected animals. Testing of local ambient air and drinking water for all five elements studied showed values to be well within acceptable limits. The same applied to the testing of most locally produced foods of animal and vegetable origin. A few species of leafy vegetables were the only human foodstuffs in which, occasionally, significantly elevated contents of lead and some of the other trace elements studied were found. However, the possibility of any health hazard related to their consumption was considered extremely remote. Human urine specimens and cattle were also studied.

32771

Hitchcock, A. E., D. C. McCune, L. H. Weinstein, D. C. MacLean, J. S. Jacobson, and R. H. Mandl

EFFECTS OF HYDROGEN FLUORIDE FUMIGATION ON ALFALFA AND ORCHARD GRASS: A SUMMARY OF EXPERIMENTS FROM 1952 THROUGH 1965. Contrib. Boyce Thompson Inst., 24(14):363-385, Jan.-March 1971. 22 refs.

The results of experiments on controlled hydrogen fluoride fumigation of alfalfa and orchard grass are presented. Alfalfa was relatively tolerant to HF with respect to the production of foliar lesions. Chlorosis appeared prior to necrosis or was induced at lower concentrations of fluoride. The symptoms were most intense along the margins of immature expanded leaflets of the leaves near the tips of main or axillary shoots. Mature leaves were more resistant. The most severe symptoms developed on alfalfa exposed for nine days to the highest dosage of HF (5.20 micrograms F/cu m). The tolerance of orchard grass was comparable. The high dosages of HF which induced foliar markings did not reduce the yield of crops harvested immediately after the fumigation or subsequently. Effects on growth, when determined, amounted to an increase in the fresh or dry weight of the plants. For each day of exposure to HF at 1 microgram F/cu m, the fluoride concentration of alfalfa tissue increased by 2-4 ppm, and that of orchard grass increased by about 1 ppm. During the post-fumigation period (8-22 days), the concentration of fluoride in alfalfa tissue decreased by 50%. (Author summary modified)

32854

Arndt, U.

AIR POLLUTION-INDUCED LEAF PIGMENT CONCENTRATION CHANGES. A CONTRIBUTION TO THE DISCUSSION OF PIGMENT ANALYSIS. (Konzentrationsanderungen bei Blattfarbstoffen unter dem Einfluss von Luftverunreinigungen. Ein Diskussionbeitrag zur Pigmentanalyse). Text in German. Environ. Pollut., 2(1):37-48, July 1971. 41 refs.

The value of pigment changes is discussed as an early indication of the effects of air pollutioon on plants. Wheat, oat, and rye plants were exposed to the effects of hydrofluoric acid, of sulfur dioxide, and of hydrochloric acid for varying periods of time and until necrosis set in; then chlorophyll A, chlorophyll B, and beta-carotene were extracted from exposed and control plants and analyzed chromatographically and spectrophotometrically. Control plants exhibited a dependence of the pigment concentration on plant strain, age, and on ecological conditions prevailing prior to and during the experiment. While the content of both chlorophyll A and B was not affected by ex-

posure to the pollutants, the content of beta-carotene decreased by 20 to 35% in plants exposed to SO2 and HCL. In plants exposed to HF, the drop was less significant. Results of this study do not warrant the use of changes in pigment content as an early indicator of the effect of pollution on plants but the question should be pursued in the case of the yellow chloroplast pigments.

32897

Desbaumes, P. and E. Bovay

DETERMINATION OF FLUORINE-IMMISSIONS BY MEANS OF STATIC ABSORPTION APPARATUS (MODIFIED HARDING METHOD). (Determination des immissions fluorees au moyen d appareils d absorption statique, type Harding modifie). Text in French. Revue Suisse de Viticulture et Arboriculture (Lausanne), 3(3):75-77, May-June 1971.

A modified Harding apparatus was used to determine the correlation between fluorine in the air and in plant leaves. The device consists of a galvanized armature attached to a pole, a group of superimposed discs holding filter paper, and a conical roof protecting the device from rain and bird droppings. The fluorine content was determined by the Belcher and West method modified by Sulzberger after the calcination of a one gram filter paper sample with calcium hydroxide. Measurements were taken near an aluminum factory and near a fertilizer plant. The fluorine content in the filters was directly proportional to the duration of exposure and inversely proportional to the distance from the source of the fluorine. The absorption of fluorine by filter paper is much less than by plant tissues because of respiration and evapotranspiration.

32982

Simonsson, Lennart

DAMAGES AND DISCOMFORTS CAUSED BY INDUSTRIAL POLLUTION OF THE ATMOSPHERE. (Skador och obehag orsakade av industriell fororening av atmosfaren). Text in Swedish. IVA (Ingenioersvetenskapsakad.) Tidstr., 26:141-163, 1955. 85 refs.

An extensive review is made of the literature of the effects on humans, livestock, and plant life of the various types of gaseous and particulate air pollutants, including sulfur oxides, hydrogen sulfide, fluorine compounds, chlorine, hydrogen chloride, nitrogen oxides, ammonia, organic compounds, and dust. Of these, the most extensive treatment is given to the effects of sulfur compounds and halides. The effects of sulfur dioxide on plants is discussed in great detail. The effect of low concentrations of sulfur compounds in the atmosphere on plant life are being studied in Sweden at the agricultural school in Ultuna.

33089

Went, Frits W.

PLANTS MONITOR AIR POLLUTION. Sci. Citizen, 7(10):6-9, Oct. 1965.

The effects of photochemical smog on plants and the use of plants as indicators of air pollution are discussed. Experiments have shown that there are at least two effects of smog which do not give any immediately visible symptoms. One is a general growth retardation. This was shown only in seedlings; it is not certain whether mature plants also show this. The second effect is a closing of the stomata of the leaf, which will decrease the rate of photosynthesis. Plants are more sensitive to smog than animals or humans, and can be used as warning devices. When signs of damage begin to appear in plants, concentrations of air pollutants which may be poisonous to animals and man are being approached. If the lower surface of spinach, beet, or swiss chard leaves show a silvery or bronzed appearance, the leaves of annual blue grass show white banding, or petunia leaves show white discolored areas, photochemical smog is indicated as cause for the damage. By observing which leaves show this damage, the date when the smog was present can be approximated, since the leaves are most sensitive during the period of expansive growth. If the leaves show a general ivory-white bleaching, or bleaching between the veins, the toxicant was probably sulfur dioxide. A brown burn around leaf edges, spotting on corn leaves, or white or yellow discoloration of the tips of gladioli indicates the presence of hydrofluoric acid. Plants in cities can constitute a vast air pollution monitoring network if many more persons are trained in the recognition of plant damage and sent throughout the country to monitor toxic air conditions.

33127

Cheo, Paul C.

SOME COMMON DISEASES OF ORNAMENTAL PLANTS IN THE LOS ANGELES AREA. Lasca Leaves, 21(2):36-45, June 1971.

Common diseases of ornamental plants in the Los Angeles area were studied and correlated to unfavorable environmental conditions, e.g., exposure to industrial emissions of sulfur dioxide, ozone, peroxyacetyl nitrate, nitrogen oxides, fluoride, and ethylene gas; nutritional disorders, e.g., lack of water, poor drainage, soil alkalinity, lack of organic matter, and salt buildup; and parasitic organisms (bacteria, fungi, viruses, phanerogamic and nematodes). Specific causes and characteristics of certain diseases, the plants they attack, and possible cures are examined.

33290

Stas, M. E.

FLUORINE POISONING FROM WASTE GASES AND DUST EMITTED BY A SUPERPHOSPHATE PLANT: DETERMINATION OF F CONTENT FROM DEPOSITS IN PLANTS, DRINKING WATER, FORAGE, AND BONES. (Fluoor-vergiftiging door rook-gassen en stof van een superphosphaatfabriek). Text in Dutch. Chem. Weekblad, vol. 38:585-593, 1941. 101 refs.

An extensive review is given of the literature on detrimental effects caused by fluorine in plants, animals, and humans, as well as the literature on methods of determining trace amounts of fluorine in water, air, and various other locales. A report is given of an original study of fluorine determination in plants, rainwater, drinking water, plant life consumed by cattle, and the bones of cattle. Results obtained in the immediate vicinity (distances of + or - 100 m and + or - 300 m from the fertilizer factory) were compared with control results from other locales. The water, grass, and hay consumed by the cattle contained high amounts of fluorine, and that the bones of cattle that died with the symptoms of fluorine poisoning contained a higher fluorine level than other cattle.

33468

Thompson, C. R., O. C. Taylor, and B. L. Richards

EFFECTS OF AIR POLLUTANTS ON L. A. BASIN CITRUS. Citrograph, 55(5):165-166, 190-192, March 1970. 5 refs.

Commercially producing lemon and orange trees were enclosed in plastic-covered greenhouses to which filtered or ambient air was introduced. Various air treatments were applied to test for the effects of total pollutants in ambient air fluoride, ozone, peroxyacyl nitrates, and nitrogen oxides). The

photochemical smog complex reduced the rate of water use, apparent photosynthesis, and yield of fruit in trees receiving ambient air. Fluoride levels in the atmosphere were too low to cause detectable effects. Leaf drop was significantly less in lemons receiving carbon-filtered air than in those receiving ambient air. A similar trend occurred in navel oranges. Fruit drop in navel oranges was also significantly less in carbon-filtered air. Yield of mature fruit is reduced in some cases by as much as 50%. (Author summary modified)

33606

Quinche, J. P., R. Zuber, and E. Bovay

A METHOD FOR THE DETECTION OF FLUOBORATE IN FERTILIZERS. (Un procede de detection du fluoborate dans les engrais). Text in French. Revue Suisse de Viticulture et Arboriculture (Lausanne), 3(3):71-74, May-June 1971. 6 refs.

The presence of fluoborate in commercial fertilizer can be detected by growing young Coleus plants in a hydroponic solution to which a small amount of the fertilizer has been added. The plants are grown for two weeks in a glasshouse or in a climatic chamber, then the leaves are plucked and dried, and fluorine and boron are determined. An abnormal and simultaneous increase of both fluorine and boron levels compared to the respective levels in control plants grown under identical conditions, but without the addition of the fertilizer, is proof of the presence of KBF4 in the fertilizer. The method is sensitive down to a fertilizer concentration of 0.1% KBF4.

33716

Matsushima, Jiro

AIR POLLUTION EFFECT TO THE AGRICULTURE AND FORESTRY. (Norin sakumotsu ni oyobosu taiki osen no eikyo). Text in Japanese. Ryusan (J. Sulphuric Acid Assoc., Japan), 24(6):22-36, June 1971. 34 refs.

Influences of sulfur dioxide, agricultural chemicals, nitrogen oxides, and hydrogen fluoride on plants and agricultural produce are discussed. A common damage of SO2 is chlorosis and withering of red pines. The mechanism of damage has not been explained satisfactorily, but it is clearly caused by SO2 oxidation reduction. A plant in its budding stage has a large respiratory capacity and a small photosynthesis ability; as leaves grow, the latter increases and the former decreases, thereby increasing production and accumulation of carbohydrate. The quantity of SO2 absorption increases with the increase in the surface area of leaves, yet a plant s SO2 absorption capacity has little to do with its respiratory capacity; it is more influenced by the tree its respiratory capacity; it is more influenced by the tree s photosynthetic capacity. This is supported by the fact that an orange tree shows the same amount of resistance when exposed to 30 C and 95% humidity in middle March and forced to bud, as it does during winter. Respiration of a tree in winter will increase in high temperature and humidity, but metabolism does not increase. When metabolism is small, the influence of SO2 is small. Spraying trees with glutathione is effective against oxidant damage but it enchances the SO2 damage. The reason might be that glutathione increases photosynthesis or impairs SO2 s reduction of photosynthesis, thus causing the tree to absorb more gas.

33906

Paluch, Jan and Irina Schalenkowa

AIR POLLUTION BY FLUORINE IN POLAND AND ITS TOXIC EFFECT ON HUMANS, ANIMALS AND PLANTS. (Die Luftverunreinigung durch Fluor in Polen und ihre toxische Wirkung auf Menschen, Tiere und Pflanzen). Text in German. Wiss. Z. Humboldt Univ. Berlin Math. Naturw. Reihe, 19(5):489-492, 1970.

The major sources of the emission of fluorine compounds to the atmosphere are aluminum phosphorus fertilizer manufacturing plants. In Poland, the superphosphate industry alone produces a fluorine emission of some 4000 to 5000 tons annually, the aluminum industry some 2000 tons. Fluorine has a toxic effect on plants and animals, generally in an area within a radius of 1.5 to 3 km. External symptoms on plants are necrosis of leaf borders which can lead to destruction of their metabolic system and eventual plant death. Some plants, like cabbage, are more resistant than others in this respect. Peach leaves, for instance, are extremely sensitive to fluorine concentrations. The plants in general absorb the fluorine through their leaves and store it; such afflicted plants represent a danger to animals and human beings if taken in as food. The biological and clinical symptoms of fluorosis are due to changes in the calcium and iodine balance in the human or animal organism. Typical externally noticeable symptoms in animals are deformations of long bones, ribs, and joints, followed by lameness. Young animals show disturbances in growth and changes on their teeth. In humans, the most well-known effects are those brought about by fluorine in drinking water. Acute fluorine poisoning can be caused by intake of food which has been contaminated by fluorine compounds. These occur in some insecticides and in some plant sprays.

34121

Schneider, R. E. and D. C. MacLean

RELATIVE SUSCEPTIBILITY OF SEVEN GRAIN SORGHUM HYBRIDS TO HYDROGEN FLUORIDE. Contrib. Boyce Thompson Inst., 24(12):241-244, July-Sept. 1970. 4 refs.

Fumigation of seven grain sorghum hybrids with gaseous hydrogen fluoride resulted in necrosis of the leaf tips and chlorotic mottle of subtending tissue. One-third of the plants were fumigated with HF at an average concentration of 7.0 micrograms F/cu m, one-third received an average of 3.9 micrograms F/cu m, and the remaining one-third received filtered, preconditioned air only. HF-induced injury to foliage was first apparent in plants exposed to the higher concentration on the fifth day of fumigation. Physiological age of the leaves influenced the appearance of foliar symptoms. The youngest (expanding) leaves were not affected by fumigation with HF, whereas the two subjacent leaves were most susceptible. No HF-induced necrosis was observed on basal leaves but mild chlorosis, similar to that which accompanies senescence, was present. Severity of injury was variable: DeKalb C44C and RS 608 were most resistant to HF-induced necrosis, whereas Northrup King 222A, Pioneer 846, RS 610, RS625, and RS 671 were more susceptible. There was no relationship between the tissue accumulation of F and the relative susceptibilities of the seven hybrid lines. Differences in accumulation were affected only by the HF concentration during fumigation. (Author summary modified)

34880

Navara, Yan and Zdenek Golub

THE EFFECT OF FLUORINE ON PLANTS. (Vliyaniye ftora na rastenlya). Text in Russian. Polska Akademia Nauk, Zaklad Badan Naukowych Gornoslaskiego okregu Przemyslowego, Mater Miedzynarodowej Konf., Wplyw zanieczyszczen powietrza na lasy, 6th, Katowice, Poland, 1968., p. 95-99. (Sept. 9-14.)

The effects of fluorine on certain physiological processes occurring in plants are summarized. Peas and cabbage are among the most susceptible while carrots, tomatoes, and poppy-seeds

are the most resistant species to fluorine, even when applied at doses as high as 3-6 g f/l. The effect of calcium, magnesium, or phosphorus on the accumulation of fluorine in pea tissues decreases in this order. The dicotyledoneous plants are more sensitive than the monocotyledoneous plants to fluorine when applied in the substratum. The disruption of the plant growth processes under these conditions is due to a decrease in the assimilation of such nutritive elements as magnesium, phosphorus, and potassium, whereby maximum fluorine accumulations occur in the plant roots. The fluorine-induced alterations in plant metabolism are manifested mainly by alteration in the water balance of the plant tissues when exposed to concentrations of 0.07 mg/cu m of fluorine in the ambient air.

35578

Leonard, C. D. and H. B. Graves, Jr.

SOME EFFECTS OF AIR-BORNE FLUORINE ON GROWTH AND YIELD OF SIX CITRUS VARIETIES. Proc. Florida State Hort. Soc., vol. 83:34-41, 1970. 6 refs.

Young Hamlin, Pineapple, and Valencia orange, Orlando tangelo, Dancy tangerine, and March grapefruit trees were grown for 28 months in fine sand in 76-by 29-ft pots at six locations, five of which were exposed to differnet levels of airborne gaseous fluorine compounds. Variable but significant reductions in yield of the six citrus varieties occurred when the spring flush leaves sampled in May 1969 contained from 20-40 ppm fluorine. These leaf fluorine contents resulted from exposure for 11 weeks to air averaging 0.23 to 0.38 ppm fluorine. In most cases, the spring flush leaves sampled in October contained two and a half times as much fluorine as those sampled in May. This increase in leaf fluorine was closely related to the mean fluorine content of air from May to October and to the additonal exposure time. There were also highly significant yield reductions from dilute hydrofluoric acid (HF) applied to bearing orange trees only during the spring blooming season. This fact and the negative correlation between fluorine content of spring flush leaves sampled in May and yield strongly suggest that most of the fluorine-induced injury occurs in the spring bloom period. However very high levels of leaf fluorine accompanied by severe chlorosis can reduce yields the next year even in the absence of fluorine exposure during the period of bloom and fruit set. Only Valencia orange showed a significant reduction in growth.

35613

Benedict, H. M. and J. P. Nielsen

THE MARKINGS PRODUCED BY VARIOUS AIR POLLUTANTS ON LEAVES. Proc. Nat. Shade Tree Conf., vol. 32:205-214, 1956.

External effects of air pollutants on the leaves of various plants include inert or insoluble dusts clogging the stomata and inhibiting light or food, and markings due to corrosive substances, e.g., sulfur trioxide. Internal effects are those caused by absorption of polluting gases or soluble particulate matter into the leaves. Both types of effects, and the characteristic markings caused by exposure to ammonia, chlorine, hydrogen sulfide, nitrogen oxides, chlorine dioxide, sulfur dioxide, hydrogen fluoride, and smog are discussed.

35877

Liebenow, H.

BEARINGS OF IMMISSIONS ON PLANTS AND LIVESTOCK. (Die Bedeutung der Immissionen fuer Pflanzen- und Tierbestaende). Text in German. Monatsh. Veterinaermed., 26(3):106-111 Feb. 1, 1971. 10 refs. (Presented at the Probevorlesung anlaesslich des Habilitationsverfahrens, Sektion Tierproducktion und Veterinaermedizin, Jan. 20, 1970.)

Plant and livestock damage from sulfur dioxide, fluorine and its compounds, ozone, and dusts is discussed. The threshold sensitivity limits for plants are 0.3 mg/cu m SO2, 0.01-0.03 mg/cu m fluorine, and 0.2 mg/cu m ozone in ambient air. Pine and fir are among the most sensitive tree species and the sugar beet appears to be the most susceptible plant to these pollutants. Macroscopic damage to plant species from SO2 includes reddish brown color of the coniferous needles and brown spots on the leaves; chlorophyllous alterations and damage of cytoplasmic organelles appear on the microscopic level. A concentration of 0.15 mg/cu m SO2 reduces the daily milk performance in cattle by 9% and the milk fat content by 8%. Aluminum and superphosphate plants are the main sources of fluorine pollutants. Fluorine and its compounds cause the blackening of needle and foliage tips and chloroplast decay in plants. Dental fluorosis is the most common fluorine-induced disease in livestock. Fluorine produces impairment of calcium and phosphorus metabolism as well as alterations in cellulose digestion processes. The bean species appears to be the most sensitive plant to ozone. Ozone causes death from lung edema in livestock and the incidence of lung and skin cancer appears to be twice as high in ozone-polluted areas than in unpolluted air. Arsenic-bearing dusts produce the most damaging effects on livestock following ingestion of dusty feed, and accumulation of dusty layers on plant surfaces hinders normal metabolism.

35880

Kerin, D.

DELIMITATION OF INDUSTRIAL EMISSIONS BY MEANS OF PLANT ANALYSIS. Protectio Vitae, 16(5):201-202, Oct. 1971. 13 refs.

Vegetation damage in areas surrounded by metallurgical and industrial plants are mainly caused by sulfur dioxide and fluorine compounds. Plants are much more sensitive than humans or animals to SO2. Many plant varieties show signs of damage at a concentration of 0.3 ppm SO2. Fluorine and it compounds are particularly injurious to cherries, grapes, plums, various ornamental plants, and vegetables. The Ontario variety of apples is very susceptible. Visible damage to buildings is also caused by this group of pollutants. For determination of the effect of the above pollutants on vegetation, needle samples were taken in September and October in polluted areas and compared to needle samples from unpolluted regions. First and second year needles were separated. Average samples were taken from 100 grams dried needles. Sulfate, lead, zinc, iron, and manganese were determined. Plants taken from the immediate vicinity of a glass work were heavily contaminated with fluorine. Concentrations of 4.0 to 25 mg F/kg dried basis were measured. The sulfur concentration was between 0.50 to 1.5% (natural concentration is 0.20%). The lead concentration ranged from 24 to 1.136 mg Pb/kg (natural concentration is 3.0 mg Pb/kg dried needles). The zinc content ranged from 136 to 495 mg Zn/kg dried needles; in unpolluted areas it is 28 to 75 mg Zn/kg.

35964

Kadota, Masaya

AIR POLLUTION AND TREES: THE CREATION OF URBAN WOODS. (Taiki osen to jumoku toshirin no zosei). Text in Japanese. Taiki Osen Kenkyu (J. Japan Soc. Air Pollution), 6(1):31-38, 1971. 14 refs. (Presented at the National Council Meeting of Air Pollution Studies, 12th, Nagoya, Japan, Oct. 27-29, 1971.)

The smoke lesions caused by various gases such as sulfur dioxide, sulfuric acid mist, chlorine, hydrogen chloride, hydrogen fluoride, oxidant, and nitrogen dioxide are reviewed. Experiments were conducted on the effect of SO2 on black pines; the increase of sulfur content in the leaves per day (approximately seven hours of exposure) was 0.004%. This figure imposed on a standard mature black pine forest (dry leaves one kg/sq m) means that the forest theoretically has a capacity for absorbing 40 mg of sulfur (80 mg SO2)/sq m/day. The accumulation of dusts on leaf surface and the necessity of green buffer areas in cities are discussed. The amount of green area required per person was calculated by the amount of oxygen discharged and carbon dioxide absorbed by photosynthesis of trees as against the O2 consumption and CO2 emission by human respiratory activities. An adult requires approximately 30 to 40 sq m of wooded area for living. These matters are to be taken into consideration in the future city planning.

35992

Oelschlaeger, Walter

THE PROBLEMS OF EMISSION MEASUREMENTS OF FLUORINE CONCERNING THE EFFECTS ON PLANT AND ANIMAL. (Problematik der Immissionsmessungen von Fluor hinsichtlich der Wirkungen auf Pflanze und Tier). Text in German. Staub, Reinhaltung Luft, 31(11):457-459, Nov. 1971. 27 refs.

The fluorine content of the ambient air can be determined by two methods: either the gaseous fluorine compounds are determined or the gaseous F compounds plus the F compounds contained in the fly ash are determined. Plant damage is almost exclusively caused by the gaseous F compounds in the atmosphere. Industries emit mostly hydrogen fluoride and silicon fluoride. These gases are easily absorbed by plants through the stomata. The damage caused by fluorine compounds found in fly ash on plants is minimal. This can be confirmed by experiments with apple, pear, and cherry trees and with lilac. The soil in which the plants grew contained 1.5 g/kg fluorines and the fly dust applied to the leaves contained 12 g/kg and 132 g/kg. After weeks of application, no injuries could be observed. Apart from the gaseous F compounds in the atmosphere, resistance, water metabolism, nutrient supply, relative humidity, and light intensity must be taken into consideration. Cattle are most sensitive to higher fluorine intakes. Fluorine compounds are either ingested with food or drinking water or inhaled. Cattle s tolerance limit for fluorine intake with the fodder is 30 to 40 ppm referred to dry substance, which is less than one mg/kg body weight. Experiments have shown that higher F concentrations in hay hardly raised the F content in bones above that in cattle receiving sodium fluoride. The same is true for the F intake from fly dust adhering to grass. Therefore it is better to use only the measurement of gaseous emissions for any evaluation of the injurious effect of fluorine. The F content on and in plants should be separately determined by the carbon tetrachloride method.

36159

Nikolayevskiy, V. S.

PHYSIOLOGICAL-BIOCHEMICAL PRINCIPLES OF THE GAS RESISTANCE OF PLANTS. In: American Institute of Crop Ecology Survey of USSR Air Pollution Literature. Gas Resistance of Plants with Special Reference to Plant Biochemistry and to the Effects of Mineral Nutrition. M. Y. Nuttonson (ed.), Vol. 9, Silver Spring, Md., American Institute of Crop Ecology, 1971, p. 1-27. 126 refs. Translated from Russian. (Also: Uch. Zap., no. 222:5-33, 1969.)

Principal advances in research pertaining to the gas resistance of plants are reviewed. The influence of toxic compounds on the anatomical-morphological structure of leaves and the physiological-biochemical characteristics of plants is considered. Also, the species of plants resistant to various compounds in different physico-geographical zones have been ascertained. Investigators have undertaken detailed studies of the chemistry of injuries to plants by acid gases, as well as the chemical mechanism of transformation of sulfur dioxide in plants and its influence on the metabolism of carbon compounds, with the aid of isotopic techniques. Considerable attention has been given to the development of methods for studying gas resistance of plants. Of major importance for a successful diagnosis and study of the gas resistance of plants is the establishment of direct indicators characterizing the degree of plant resistance. The effects of ammonia, mercury, acids, fluorine, chlorine, and other pollutants on plants are described.

36742

Haselhoff, E. and G. Lindau

SMOKE INJURIES OF VEGETATION. HANDBOOK FOR DIAGNOSING AND EVALUATING SMOKE INJURIES. (Die Beschaedigung der Vegetation durch Rauch. Handbuch zur Erkennung und Beurteilung von Rauchschaeden). Text in German. Leipzig (East Germany), Gebrueder Borntraeger, 1903, 412p. 124 refs.

Smoke generation, characteristics and progression of smoke injuries, causes of necrotic changes in plants, and comparisons of smoke injuries with normal processes in plants are investigated. The effects of sulfurous and sulfuric acids, chlorine, hydrochloric acid, hydrofluoric acid, nitric acid, acetic acid, ammonia, hydrogen sulfide, bromine, tar and other organic substances, asphalt, and methane on plants were determined. Sulfuric acid content of the soil was not increased by acute and continuous exposure to gases containing sulfur dioxide; even an increase in soil sulfate content would not damage plants. Plant damage due to SO2 effects on leaves was examined. Injuries due to SO2 included depression of transpiration; exposure to hydrochloric acid impaired assimilation. Metal compounds, introduced into the soil through fly ash, could affect plant roots. Mercury vapor emissions were very damaging to plants, resulting in black spots and fading. The value of plant and soil studies, sampling techniques, chemical analyses, botanical studies, and preventive measures were discussed.

36785

Dreher, K. von

POISONING OF BEES BY FLUOR. (Fluorvergiftungen bei bienen). Text in German. Bull. Apic. Doc. Sci. Tech. Inform. (Nice), 8(2):119-128, 1965.

In order for laboratories analyzing bees for fluorine compounds to obtain comparable results, the average of fluor per bee should be established and the bees should be washed before analysis to eliminate exogenous impurities. Analysis of healthy bees in industrial areas showed that the percentage of fluor is lower in wintering bees than in summer bees. Bees from an experimental apiary near an aluminum factory contained an average of 9.85 micrograms per bee, with an average of 15-25 micrograms for poisoned bees. Sensitivity varies with age for healthy bees. A toxicity threshold of 10 micrograms is suggested. When different parts of the body were examined, 91% of the fluor was found in the abdomen and 83% in the middle gut.

36787

FRICTION WITH FLORIDA FARMERS. Chem. Week, 76(14):28, April 2, 1955.

Gladioli and tomato growers in the Tampa area claim that stack gases from a local phosphate plant are damaging their crops. As compensation for the alleged damage, 22 agricultural firms and individual farmers are seeking judgements against the company totaling nearly $1.5 million. The plant maintains that it has installed the most modern air-pollution control equipment, while the state Board of Health believes that the pollutant in question comes from putrefaction of waters in Tampa Bay and not from phosphate plants. One theory holds that crop damage from phosphate plants may be due to a fluorine compound formed in treating phosphate rock.

36883

LeBlanc, Fabius, Gilberte Comeau, and D. N. Rao

FLUORIDE INJURY SYMPTOMS IN EPIPHYTIC LICHENS AND MOSSES. Can. J. Botany, 49(9):1691-1698, 1971. 22 refs.

To study in situ the effects of fluorides on lichens and mosses, lichen- and moss-bearing bark discs were cut from trees in an unpolluted area of Arvida, Quebec, and transplanted in groups of six onto trees in an area polluted by an aluminum factory. Fifteen sites, in addition to a control site, were selected in different directions from the factory. At each site, two boards on which the bark discs were fixed were nailed to a tree. One board was removed after four months exposure and the other after 12 months. The lichens and mosses in both control and polluted areas were compared with respect to color, external morphology, plasmolysis in algal cells, loss of green color, nature of reactions toward neutral red and 2,3,5-triphenyl-2H-tetrazolium chloride, absorption spectra of chlorophyll, and fluoride concentrations. Results indicate that fluoride pollution affects moisture balance, causes chlorophyll damage, and produces other symptoms of injury which could lead to the ultimate death of these organisms. At the end of 12 months, lichen fluoride concentrations ranged from 134 ppm at 15 km NE of the factory to 990 ppm at one km E. Moss fluoride concentrations were always lower than lichen concentrations. (Author abstract modified)

36994

Scholl, G.

INFLUENCE OF PHYTOTOXIC EMISSIONS ON THE GROWTH OF HORTICULTURAL AND AGRICULTURAL CROPS. (Einfluss phytotoxischer Immissionen auf das Wachstum landwirtschaftlicher und gaertnerischer Kulturen). Text in German. Landwirt. Forsch. Sonderh., no. 19:166-176, 1965. 20 refs.

The effect of emissions from a metallurgical plant, including sulfur dioxide and fluorine derivatives, on plant growth was investigated during a three-year period. The 12 month average SO2 content ranged from 0.24 to 0.30 mg/cu m above the two experimental lots. The damaging effects were focused on the leaves and consisted in color alteration and necrosis. Plant growth and yield effects varied according the climatic conditions, species, and stage of growth. Winter rye and leek appeared to be the most emission-resistant species. Highest yield losses were produced in certain bean species, spinach, and summer barley. Barley accumulated the highest amount of sulfur which increased from 0.54 to 0.83% (dry matter) in the leaves at the end of the third year of the experimental period. Fluorine content ranged from 3.0 (spinach) to 26.2 (summer barley) mg/100 g dry matter during the second year of the experiment.

36996

Hajduk, Juraj

EXTENSION GROWTH IN SEEDLINGS AS A BIOLOGICAL TEST OF SOILS CONTAMINATED WITH FLUORINE EXHALATES. (Verlaengerungswachstum der Keimlinge als biologischer test von durch Fluorexhalate intoxizierten Boeden). Text in German. Biologia, 24(10):728-737, 1969. 19 refs.

Biological tests based on measurements of pea and barley seedling root extension growth to evaluate the toxicity of fluorine exhalates from an aluminum plant were carried out. The aluminum plant is located in the Hron River Valley and exposed to northwest and north winds with a hilly background on its southern side; the location is characterized by 30% still days/year. Soil located varying distances from the emission source and control soil treated with known amounts of dust from the fusion electrolysis shop of the factory were used for the seedling growth experiments. Lowest growth rates of pea seedling roots appeared on the soil exposed to the highest amounts of fluorine contamination as affected by meteorological and topographic interactions. Inhibition of pea seedling root growth was well correlated with the amounts of fluorine-contaminated dusts added to the control soils. Pea seedlings can be utilized as a biological testing species for the evaluation of fluorine contamination of soils exposed to this pollutant. Barley seedlings elicited irregular reactions and, thus, were rejected as unsuitable for similar tests.

36998

Wentzel, K. F.

THE EFFECTS OF INDUSTRIAL AIR POLLUTANTS AND LIME FERTILIZERS ON SMOKE-EXPOSED GROUNDS. (Zur Bodenbeeinflussung durch industrielle Luftverunreinigungen und Duengung in Rauchschadenslagen, insbesondere mit Kalk.) Text in German. Forst-Holzwirtschaft, 14(8):178-182, 1951. 31 refs. (Presented at the Bezirksgruppentagung, des Bundes Deutscher Forstmaenner, Muenster, West Germany, Jan. 22, 1959.)

While air is only a temporary carrier of industrial pollutants, the soil is the final site of their absorption. Sulfur dioxide and fluorine compounds are the main smoke constituents and metal oxides and silicic acid are the main dust constituents absorbed by soil. Sulfur dioxide containing smoke elicits an acid pH. Conversion of SO2 into sulfurous or sulfuric acid which is then conveyed into the ground by rain or snow increases soil acidity. The available free bases of the soil are then converted into insoluble sulfates, depriving the plants of an important nutritional requirement. Forests are the most susceptible to damage from smoke because of their poor buffering properties and their initial low base contents. Metallurgical processing, cement, and electric power producing plants are the main dust emission sources. Dusts may elicit acid, neutral, or alkaline pH, according to their chemical composition. Dust fall inflicts severe damage to soil structure. Application of fertilizers such as lime would prevent the acidifying effects from smokes and would improve plant resistance against noxious agents. Fertilizer application would also provide a means for the protection of soil structure.

37346

Daessler, H. G.

THE EFFECT OF HYDROGEN FLUORIDE AND CRYOLITE DUST UPON PLANTS AND ANIMALS NEAR A HYDROGEN FLUORIDE FACTORY. Fluoride, 4(1):21-24, Jan. 1971. 3 refs. (Presented at the International Society of Fluoride Research Conference, 3rd Annual, Vienna, Austria, March 22-25, 1970.)

To clarify damage due to fumigation by hydrogen fluoride and cryolite (sodium aluminum fluoride) dust, studies were carried out on fruit trees, agricultural plants, vegetables, and ornamental plants in the vicinity of a hydrofluoric acid factory. The development of toxic symptoms, differences in sensitivity between plant species, and extent of leaf and fruit damage are described. Plants resistant to F(-) pollution were sour cherries, raps, sugar beets, potatoes, cabbage, asters, and roses. In fruit trees, the sensitivity of leaves did not parallel that of fruit. Fumigation experiments with HF in air mixtures produced results that agreed closely with the field observations. Fluoride intoxication in milk cows near the factory was manifested by reduced milk production. The bee population suffered substantially from F(-) emissions. (Author abstract modified)

37403

Woltz, S. S., W. E. Waters, and D. C. Leonard

EFFECTS OF FLUORIDES ON METABOLISM AND VISIBLE INJURY IN CUT- FLOWER CROPS AND CITRUS. Fluoride, 4(1):30-36, Jan. 1971. 11 refs. (Presented at the Conference of the International Society of Fluoride Research, Annual, 3rd, Vienna, Austria, March 22-25, 1970.)

Experiments were conducted to determine the susceptibility of horticultural crops grown in Florida to damage from fluorides. Atmospheric fluorides were considered, as well as fluorides derived from soil and water. Fluoride taken up by gladiolus roots caused foliar damage only when soil pH was low and F(-) containing superphosphate was applied in relatively excessive amounts. The damage to leaves occurred more to leaf interior than to margins and tips as in F(-) fumigation. Fluoride in leaves moved passively with the transpiration stream of water and accumulated at the terminus of translocation. Rose and gladiolus cut flowers were damaged by low F(-) concentrations in vase water, while chrysanthemums were less affected. De novo chlorophyll synthesis in Vigna sinensis seedling leaves was inhibited by F(-) absorbed by detached seedling tops. The yield of Valencia orange fruit was depressed by airborne F(-). Valencia leaves were reduced in size, had decreased photosynthetic rates, and had decreased chlorophyll content in response to increasing levels of airborne F(-). (Author abstract modified)

37480

Rippel, A.

EFFECT OF FLUORIDE EMISSION ON ANIMAL PRODUCTS. Fluoride, 4(2):89-92, April 1971. 8 refs. (Presented at the International Society of Fluoride Research Conference, Annual, 3rd, Vienna Austria, March 22-25, 1970.)

Fluoride assays were made over a 3-year period of milk and eggs produced by animals raised within 100 m of an aluminum smelter. Milk from eight cows, 4 to 9 yrs old, averaged 0.6 mg fluoride/l. Milk produced in the morning contained an average of 0.5 mg F, while evening milk contained 0.7 mg F/l. The highest fluoride, content, an average of 0.94 mg/l for 18 months, was noted in the milk of a young heifer. The F(-) in th yoke of chicken eggs averaged 1.2 ppm. This value was only slightly higher than that of the controls (1.1 ppm). However, the fluoride content of egg shells in the exposed area was nine times higher than in the control eggs. The differences in thr fluoride content of milk and eggs confirms the fact that poultry are relatively more resistant to fluoride emissions than cattle. (Author abstract modified)

37567

Oelschlaeger, W.

FLUORIDE UPTAKE IN SOIL AND ITS DEPLETION. Fluoride, 4(2):80-84, April 1971. 6 refs. (Presented at the International Society of Fluoride Research Conference, Annual, 3rd, Vienna, Austria, March 2-25, 1970.)

The magnitude of fluoride uptake by soil from artificial fertilizers was determined. The values were compared with the amount of F(-) removed through harvesting crops and through seepage water. Fertilization of cereals, potatoes, grass, fodder, beets, and sugar beets with superphosphates added from 8-20 kg F(-)/ha to soil. On the other hand, these plants, when harvested, contained only 5-80 g F(-)/ha or 0.1-0. 4% of the added F(-). The F(-) accumulation in soil containing 200 ppm F(-) (a general average) after fertilization with superphosphate was 1.3-4.5% annually. Removal of F(-) from soil by seepage water was estimated at 30 widely separated agricultural and wooded areas. Fluoride loss through seepage water averaged 52-208 micrograms/l, depending on levels of clay and lime in the soils and on the marked relation between the F(-) content of the water and the runoff. From 0.5-6% of the yearly added increment was thus removed. In a nonpolluted area, therefore, considerable amounts of F(-) accumulate in soil from fertilizers. In some instances, they constitute up to 90% of the amounts which are added to the ground. (Author abstract modified)

37792

Rao, D. N. and D. Pal

A VOLATILE FLUORIDE GENERATOR FOR FUMIGATING PLANTS. Fluoride, 5(1):18-21, Jan. 1972. 5 refs.

A simple apparatus for generating volatile fluoride in controlled amounts is described. A polyethylene reservoir is mounted over an atomizer and a feeder cup containing a solution of hydrofluoric or hydrofluorsilicic acid as a source of volatile fluoride. A syphon tube, fitted with a flow regulator, connects the reservoir to the feeder cup. The atomizer, consisting of a capillary tube, a compressed air nozzle, and a basal tube, converts the fluoride solution into a mist of fine droplets which pass into a heating tube and are converted to gas. Heavier droplets condense on the atomizer cover, and the resulting liquid is returned to the feeder cup. Due to the solution returning from the atomizer and the fresh solution coming from the reservoir, the level of liquid in the feeder cup remains more or less constant. This arrangement helps to maintain a constant concentration of the atomizing solution. The equipment is portable and can be used to fumigate plants at any location. It can be used to test plant damage from fluorides or absorption of fluoride under controlled conditions.

38017

Guderian, R., H. van Haut, and H. Stratmann

PLANT-DAMAGING HYDROGEN FLUORIDE CONCENTRATIONS. (Pflanzenschaedigende Fluorwasserstoff-Konzentrationen). Text in German. Umschau (Berlin), 71(21):777, 1971. 2 refs.

Because of increased emissions of fluorine-containing gases from plants manufacturing aluminum, copper, superphosphate, glass, or cement, tests were conducted to determine the effect of various concentrations of atmospheric hydrogen fluoride on a variety of plants. Varying harmful effects were noted with concentrations of 0.85-4.2 micrograms/cu m in air, but no definite conclusions regarding allowable concentration limits were reached.

38332

Daessler H. -G. and S. Boertitz

EFFECTS OF AIR POLLUTANTS ON AGRICULTURAL PRODUCTS. (Zur Wirkungsweise von Luftverunreinigungen auf landwirtschaftliche Erzeugnisse). Text in German. Biol. Zentralbl., 90(5):611-619, Sept./Oct. 1971. 12 refs.

With the aid of simplified graphs, the specific effects of sulfur dioxide fluorides, and indifferent and toxic (lead, zinc, and arsenic containing) dusts on agricultural plants in the German Democratic Republic are shown. Continuous and long-term exposure to low S02 concentrations impair the photosynthesis (carbon dioxide assimilation), which in turn affects the quantity and quality of plant products. Most characteristic is the reduction of crop yield. Moreover, the S02 intake raises the sulfate level in plants. Relatively high S02 concentrations cause the death of cells, photosynthesis does not take place any more in necrotic tissue. Exposure to fluorine-containing emissions and to dusts leads to an accumulation of these pollutants in the plants to an extent which might be harmful to animals. Exposure of plants to non-toxic dusts such as fly ash and soot causes considerable changes of the plant metabolism. Toxic dusts inactivate ferments and retard root growth.

38343

McCune, D. C.

PROBLEMS INVOLVED IN DEVISING AIR QUALITY CRITERIA FOR THE EFFECTS OF FLUORIDES ON VEGETATION. (Am. Ind. Hyg. Assoc. J.), 32(10):697-701, Oct. 1971. 14 refs.

Air quality criteria function as guidelines to acceptable air quality which requires that they should be complete, accurate, and useful presentations of the evidence. The problems for presenting accurate data for air quality criteria for effects of fluoride on vegetation are discussed. The available information is insufficient in depth and scope to allow unequivocal statements about the effect of fluorides on plants. The variety of effects, receptors, and conditions necessitate a number of simplifying assumptions if data are to be collated. Also, unless some desired air quality objective and the conditions for achieving it are given, the body of information in the criteria may not be presented in its most effective or useful form. Illustrations for the problems include studies on the effects of hydrogen fluoride on alfalfa. (Author abstract modified)

38404

MacIntire, Walter H.

AIR VERSUS SOIL AS CHANNELS FOR FLUORIC CONTAMINATION OF VEGETATION IN TWO TENNESSEE LOCALES. Interdepartmental Committee on Air Pollution, Washington, D. C., Air Pollut., Proc. U. S. Tech. Conf., Washington, D. C., 1950, p. 53 - 58. 2 refs. (May 3-5, Louis C. McCabe, ed.)

Long-term (20-year) field and experimental studies are reported of the processes through which forage vegetation may acquire an abnormal fluorine content; the work was initiated in response to complaints that fluorine emissions from nearby industry were causing damage to plants and livestock. Results indicate that soils possess distinctive capacities to fix additive fluorides against rain-water leaching and against migration of the fluorine ion into above-ground forage crops, and that such migration is repressed in soil systems that contain adequate supplies of calcium. Abnormal fluorine content in the vegetation of certain locales in Blount County (eastern Tenn.) is attributed to direct contamination from the hydrofluoric acid that is emitted to the atmosphere through the manufacture of aluminum. In the absence of fluoric dusts and without mechanical pollution from phosphatic soils, fluoric contamination of forage vegetation in Maury County (middle Tenn) apparently comes directly from the fluoric effluents present in that atmosphere, rather than through uptake of florides from the soil. (Author summary modified)

38407

Phillips, Paul H.

FLUOROSIS IN LIVESTOCK. Interdepartmental Committee on Air Pollution, Washington, D. C., Air Pollut., Proc. U. S. Tech. Conf., Washington, D. C., 1950, p. 123 - 126. 1 ref. (May 3-5, Louis C. McCabe, ed.)

Gaseous effluents from industrial activities may be important contributors to chronic fluorine poisoning in livestock. The three principal syptomatologic features are described in the order in which they occur: effects on the dental structures, the skeletal system, and the protoplasmic mass. Experimental feeding of raw rock phosphate fluoride to cattle resulted in an intake of 2 mg/day/kg body weight with safety; 4 mg was an unsafe level. Conversion of the results of these studies to the fluorine equivalent of the more soluble NaF would mean that 41-45 ppm NaF would not affect growth or milk and butter fat production; 75-87 ppm would affect milk production but not growth. A laboratory analysis of the fluorine level in the long bones of the legs provides an essential check in diagnosing fluorosis, since some of the symptoms are non-specific. The normal fluorine content in these bones is 200-1000 ppm, and no growth retardation or reduced yield of milk or butter fat occurs unless the average concentration exceeds 5000 ppm.

38411

Davidsson, Ingolfur

INCREASED FLUORINE POLLUTION. (Vaxandi fluormengun). Text in Icelandic. Freyr, 67(7/8):167-168, April 1971.

General problems of air pollution are outlined with special regard to fluorine. Damage caused by fluorine was observed in coniferous forests near Ragnars Peturssonar during the second part of the vegetation period. Red to brown spots appeared on the needles in August. In November, whitening of the needle edges was observed, which was followed by necrosis. Fluorine concentrations up to 193 ppm were measured in this area. Coniferous forests were damaged by fluorine-bearing dusts in concentrations of 10-20 ppm in Norway.

38412

Horntvedt, Richard

EFFECTS OF AIR POLLUTION ON FORESTS. (Virkninger av luftforurensninger pa skog). Text in Norwegian. Norsk Skogbruk, 17(1):3-4, 1971.

Direct and indirect effects of air pollution and related investigations for a glass-fiber plant are described. Direct damage caused by gaseous and particulate pollutants has a local character. Damage to forests was observed around a glass-fiber processing plant emitting fluorine and sulfur dioxide in amounts of 3 kg and 20 kg/hr, respectively. Knowledge of meteorological data such as wind speed, stability, and stack height, and emission volume allow correct forecast of concentrations at different distances. The respective thresholds applied for HF and SO2 were 1 microgram/cu m and 0.5 micrograms/cu m. With neutral stability, HF concentrations exceeding the above threshold could be anticipated at a distance of 5 km in wind direction. Synergetic effects of HF and SO2, and a minimum exposure time of 10 days were considered. The proliferation of insects and the reduced resistance to drought

and frost are some of the indirect effects of air pollution. Increasing soil acidification due to SO2 is also a general phenomenon. A pH value of 4.7 was measured in 1967 against pH of 5.3 in 1957. The increase in acidity was calculated as 1.5 %/yr.

38417

Largent, Edward J.

THE EFFECTS OF AIR-BORNE FLUORIDES ON LIVESTOCK. Interdepartmental Committee on Air Pollution, Washington, D. C., Air Pollut., Proc. U. S. Tech. Conf., Washington, D. C., 1950, p. 64 - 72. 12 refs. (May 3-5, Louis C. McCabe, ed.)

Fluorides carried through the air and deposited on pastures and fields of forage pose a hazard of chronic fluorosis to livestock fed on these plants. Previous reports on the mechanism and symptoms of fluorosis occurring in livestock near factories are reviewed. An investigation is described in which cattle kept on a farm in the vicinity of a rock phosphate plant developed clinical fluorosis. The results of measurements of fluoride concentrations in the atmosphere over the farm, in samples of vegetation grown on the farm, and in the tissues of the exposed cattle are given. Fluoride levels in both air and vegetation decreased as the distance from the factory increased. Concentrations of fluoride in the bones of affected animals were abnormally high.

38419

Massey, L. M.

SIMILARITIES BETWEEN DISEASE SYMPTOMS AND CHEMICALLY INDUCED INJURY TO PLANTS. Interdepartmental Committee on Air Pollution, Washington, D. C., Air Pollut., Proc. U. S. Tech. Conf., Washington, D. C., 1950, p. 48 - 52. 13 refs. (May 3-5, Louis C. McCabe, ed.)

Plant effects induced by sulfur dioxide and hydrogen fluoride are used to illustrate the difficulties in diagnosing cases of suspected injury from phytotoxic gases. Disease (i.e., injury) caused by such chemicals is a continuing process paralleling disease caused by living organisms, with chemical analysis of plant tissue used instead of microscopic examination and culture of the living organism to identify and confirm the diagnosis. Despite extensive knowledge of the characteristic symptoms produced by SO2, field diagnosis is often complicated by the wide variety of markings caused by such factors as drought, frost, winter injury, insects, disease, and various physiologic disorders. Thus, some knowledge of the conditions of exposure, weather factors, and the reaction of susceptible indicator plants is necessary. Sulfur dioxide and hydrogen fluoride produce symptoms that are similar in certain respects and difficult to distinguish. Problems in using color values, tip burn, and foliage injury to conifers as diagnostic symptoms are discussed.

38568

Treshow, Michael

FLUORIDES AS AIR POLLUTANTS AFFECTING PLANTS. Ann. Rev. Phytopathol., vol. 9:21-44, 1971. 91 refs.

The pathological effects of fluorides on plants are reviewed with respect to fluoride sources, symptomatology, environmental influences, host-parasite relations, injury control, and air quality standards. The major sources of flouride emissions are producers of aluminum, ceramics, phosphate, and occasionally steel. Toxic concentrations of fluoride are largely airborne and absorbed by the leaves. Fluorides occur naturally in soils, but soil contamination may occasionally also provide an index of corresponding air contamination. Toxicity is influenced primarily by fluoride concentration, duration of exposure, and sequence and frequency of exposure, but may be modified by climate, e.g., temperature and humidity, soil factors, synergistic effects of other pollutants, and biological factors. Visible symptoms of fluoride damage, e.g., chlorosis, necrosis, and tip burn, metabolic and cytogenetic effects, and effects on growth and production are considered. The effects of fluorides on host-parasite interaction are also discussed. Fluoride injury controls include the application of protective chemicals, the development of resistant species, and basic elimination of the pollutant. For the highest degree of control, air quality standards are best based on the atmospheric fluoride concentrations capable of injuring the most sensitive plant species.

38574

Dybczynska, Krystyna

POLAND S FORESTS HIT BY AIR POLLUTION. (Luftfororening hot mot polska skogar). Text in Swedish. Tek. Tidskr., 101(20):30-31, Dec. 1971.

Gaseous emissions amount to about three million tons yearly in Poland, with sulfur dioxide predominant. Precipitation adds 100 kg of sulfuric acid to one ha yearly. Dust is emitted in an amount of five million tons/yr. Forests near industrial areas are attacked by sulfur dioxide and nitrogen gases. One half of all trees are more or less seriously damaged in a total forest area of 300,000 ha which accounts for 3.5% of the total forest area. Thermal power plants consuming coals with 0.5-4% sulfur represent a major danger. Chemical plants, emitting primarily sulfur dioxide, pollute the air in a radius of 15 km; 500 ha of forest was destroyed, 700 ha damaged, and 4000 more ha affected by a chemical plant producing nitrogen-containing fertilizer, for example. The metallurgic industry is the source of 7% of the total SO2 emission, and dust and metal fluorides emissions are not negligible. While there are no resources available, a law for the protection of the atmosphere was inacted in 1966. In the period from 1971 to 1975 an increase of investments for pollution control by 150% is planned.

38754

Tomatsuri, Masaru

EFFECT OF HYDROGEN FLUORIDE ON PADDY RICE. (Sulto ni oyobosu fussoka suiso no eikyo). Text in Japanese. Taiki Osen Kenkyu (J. Japan Soc. Air Pollution), 6(3):336-342, Dec. 1971. 2 refs.

The effect of low concentrations of hydrogen fluoride on paddy rice was investigated with respect to HF toxicity and threshold value. Paddy rice was exposed to 2-5 ppm HF gas for 10-40 days. The fluorine content of the leaf blade and fluorine concentration in the air were positively correlated but there was no visible injury to the plants. Even under conditions of 40-day exposure to 5 ppb of HF gas, there was no difference between the fluorine content of the hulled rice, the weight of 100 grains, and the weight of straw of the exposed rice plants and the control plants.

39098

Ballantyne, David J.

FLUORIDE INHIBITION OF THE HILL REACTION IN BEAN CHLOROPLASTS. Atmos. Environ., 6(4):267-273, April 1972. 21 refs.

The Hill reaction (oxygen evolution) of bush bean chloroplasts was inhibited by potassium fluoride within a pH range of 4.8-

5.7. No inhibition was detected at higher pH s, and no inhibition occurred at pH 5.6 if the potassium fluoride was injected into a chloroplast preparation with a solution of magnesium chloride or sulfate already added. However, if the magnesium chloride or sulfate was added to a preparation that already contained potassium fluoride, then there was no alleviation of the inhibition. Magnesium appeared to act by reducing fluoride concentrations in reaction mixtures. A decrease in fluoride inhibition at 5.6 occurred when the concentration of potassium chloride was increased. Sodium monofluoroacetate was not as effective as potassium fluoride in inhibiting the Hill reaction. (Author abstract)

39159

Rippel, A.

FLUORIDE INTAKE FROM FOOD. Fluoride, 5(2):89-91, April 28, 1972. 3 refs. (Presented at the International Society for Fluoride Research, Annual Conference, 4th, the Hague, Netherlands, Oct. 24-27, 1971.)

In order to evaluate the safety of food grown near a Czechoslovakian aluminum smelter, grain and vegetables were assayed for their fluoride content at varying distances from the smelter during a 10 year period. The fluoride content of green parsley leaves was 11.57 ppm (control 0.66); the roots contained 0.08 ppm (control 0.03) and the outer surface of root contained 0.12 ppm (control 0.03). Relatively little fluoride was found in potatoes. At a distance of 80-130 m in the area of the prevailing winds, the fluoride content of the grain varied within 6.34-19.64 mg/kg. At a distance of 500 m, the fluoride levels of grain were reduced to about 35% and at 1 km to about 15% of these values. Grain cultivated in a circular area with a diameter of 2 kilometers from the source of emission should not be consumed locally but can be exported for use in uncontaminated areas, and fluoride should not be added to drinking water in the vicinity of a fluoride-emitting factory. (Author summary modified)

39183

Bossavy, J.

THE ACTION OF GASEOUS FLUORINE COMPOUNDS ON FOREST SPECIES. (Action des fluorures gazeux sur les especes forestieres). Text in French. National Society for Clean Air, London (England), Itern. Clean Air Congr. Proc., London, England, 1966, p. 193-196. (Oct. 4-7, Paper VI/13.)

Fluorine pollution-induced damage on woody species and measures to be taken to prevent such damage are reviewed. In leaf-bearing trees, fluorine migrates to the boundary portions of the leaf and produces tip or marginal necrosis as soon as the toxicity threshold is reached. Leaf necrosis is produced in certain species by 0.025 ppm fluorine concentrations in the air. Continuous accumulation if fluorine contents by coniferous species is illustrated by data accumulated during 1963-1965 in France. Thus, one year old needles had 277 mg fluorine/kg dry matter at 900 m altitude, 138 at 1300 m altitude, and 47 at 1520 m altitude; two year-old needles had 635, 200 and 85 mg fluorine/kg dry matter at the corresponding forest sampling points located six to ten km distance from the polluting source. Leaf-bearing trees show a tendency to accumulate fluorine within the same season to a higher extent than the coniferous species. Thus, beech tree leaves may accumulate up to 970 mg fluorine/kg, maple leaves may accumulate up to 675 mg/kg, and oak leaves may gather up to 421 mg fluorine/kg within one season. Despite such elevated concentrations, premature leaf fall seldom occurs. Apparently, the annual leaf fall prevents the accumulation processes occurring in the coniferous species. Long therm effects of fluorine pollution lead to soil alterations which may hamper large forest areas. Accumulation of fluorine bearing dust particles on the ground surface and their further infiltration by rain and snow waters may produce chemical alterations of the superficial soil layer. These alterations include increased acidity which modifies the bacterial flora and produces impairment of calcium and nitrogen mobilization within the vital soil layer. Soil treatment with appropriate salt or alkaline additives as well as continuous fertilizer treatment to increase plant resistance against air pollutants are considered among the essential measures to be taken to prevent these damaging effects. Experimental studies show only partial benefits, limited mainly to young populations, from the application of such procedures. Reference is made to new protective procedures adapted in the USA and Germany, which promise new prospectives for the future.

39190

Hoericht, W.

FOREST DEVASTATION FROM SMOKE. (Waldverwuestung durch Rauch). Text in German. Kranke Pflanze, vol. 15:90-92, 1938.

The chief sources of gases (sulfur dioxide, sulfuric acid, hydrochloric acid, and hydrofluoric acid) that poison forests are domestic heating, cellulose, and other industry plants. The damages caused to trees by these gases are very different, so no diagnosis can be established. Due to their exposure, lasting for many years, pine woods are more sensitive to sulfur dioxide and other poisonous gases contained in air than deciduous trees. The symptom of the damage is, in general, the reddening of the leaves and needles. Even if the air does not contain harmful gases, the dust and soot deposited on leaves and other organs reduce the respiration activity of the plants. Employing species more resistent to smokes cannot be regarded as a genuine solution to the pollution problem in forestry.

39328

Haut, Hans van

ANALYSIS OF SEVERAL AIR POLLUTION COMPONENTS WITH KALE (BRASSICA OLERACEA ACEPHALA) AS INDICATOR PLANT. (Nachweis mehrer Luftverunreinigungskomponenten mit Hilfe von Blaetterkohl (Brassica oleracea acephala als Indikatorpflanze)). Text in German. Staub, Reinhaltung Luft, 32(3):109-111, March 1972. 18 refs.

Kale (brassica oleracea acephalia) was used for identification of fluorine, chlorine, sulfur, and lead air pollutants. The plants were exposed to the atmosphere at various sites in the Ruhr valley. Plastic boxes with 60 l volume were used for growing the plants. The fluorine concentration was determined by the electrometric method developed by Reusmann and Westphalen, the chloride concentration by the familiar method of potentiometric titration, and the sulfur concentration by the microanalytic method by Stratmann. The lead concentration was determined by inverse-polarographically. For the determination of these components by the mentioned methods only 5 g dry substance are needed. The plants, five in a pot, were exposed over several successive years from the beginning of August to the middle of November. Control plants were exposed outside the Ruhr valley in an entirely emission-free area. The F-level in the plants was in all cases above (with one exception) that of the control plants. It ranged from 4.1 to 20.1 mg/100 g dry substance. In washed leaves, the F concentrations were lower by 15 to 30%. The chloride concentration in the plants from the polluted area was four times the concentration in the control plants, the lead concentration was ten times the concentration in the control plants. The highest sulfur dioxide was 1.83% versus 1.33% in the control plants. The

results show that kale serves well as an indicator for the mentioned pollutants, as well as for a number of polycyclic hydrocarbons, including the carcinogenic benzo(a)pyrene.

39363

Wei, Ling-ling and G. W. Miller

EFFECT OF HF ON THE FINE STRUCTURE OF MESOPHYLL CELLS FROM GLYCINE MAX, MERR. Fluoride, 5(2):67-73, April 28, 1972. 8 refs. (Presented at the International Society for Fluoride Research, Annual Conference, 4th, the Hague, Netherlands, Oct. 24-27, 1971.)

The effects of hydrogen fluoride on soybean leaves fumigated with 40-50 ppb HF were examined. In the cytoplasm the presence of small vacuoles was the first noticeable initial change. The fragmentation of the vacuolar membrane occurred either simultaneously or followed immediately. Lipid-droplet-like globules and numerous vesicles occurred subsequently in the cytoplasm and increased as the injury became more severe. There was a decrease in polysomes and a detachment of ribosomes from the rough endoplasmic reticulum. Free ribosome concentration also decreased as the injury became severe. Mitochondrial modifications involving dilation of outer and cristae membranes followed by reduction of both cristae number and matrix electron density and the disappearance of mitochondrial granules were observed in the chlorotic leaves. Electron dense inclusions accumulated in some mitochondria. The first noticeable change observed in the chloroplast was the presence of clusters of phytoferritin granules within the stroma after only 2 days of fumigation. Alterations in nuclear structures were observed in later stages of injury. Numerous small electron dense particles were found on various types of membranes in cells of severely chlorotic leaves. They were distributed on outer mitochondrial membranes, endoplasmic reticula, dictyosomes, tonoplasts, plasmalemma, nuclear envelopes, and disintegrating organelles and vesicles, but were never observed on membranes of chloroplasts and microbodies. (Author summary modified)

39466

Kisser, J.

SMOKE DAMAGES OF FOREST FROM THE BIOLOGIC STANDPOINT. (Forstliche Rauchschaeden aus der Sicht des Biologen). Text in German. Mitt. Forst. Bundesvers., no. 73:7-48, 1966. 67 refs. (Presented at the Symposium on Smoke Damage to Forests in Austria, Vienna, Austria, Nov. 9-11, 1965.)

The biological aspects of smoke damage are reviewed with special regard to forests. Due to long exposures, smoke is more harmful to forests than to farm plants. Forest damage is termed as injuries and disfunctions causing economic losses. Invisible physiological damage due to protoplasm lesions is counteracted by the regenerative effect of certain enzyme systems. Insoluble solid emissions reduce both light and assimilation, while soluble particles may penetrate the plant or soil, causing changes in the vegetation. Damage caused by soot and photochemical smog is detailed. Sulfur dioxide and hydrofluoric acid are two basic gaseous pollutants damaging forests. The importance of the damage is primarily determined by concentration and duration of exposure, with emphasis on concentration. In high concentrations, the substances are dissolved in the mesophyll cell wall fluid, causing point-like necrosis. Low concentrations lead to necrosis on the ends and edges of leaves and needles. The basal and end parts of the needles show different osmotic pressures. Due to disturbances in the water supply, the necrosis starts from the top part of the tree. Invervals between intermittent exposures lessen the damage. Damage is also influenced by climatic factors. The assimilation is dependent on light intensity and duration. Transpiration and consequently sensitivity to SO2 are dependent on relative humidity. A sharp increase in sensitivity can be observed from 60 to 90% relative humidity. There is no direct connection between transpiration rate and assimilation performance. High transpiration coefficients are characteristic of dry climates. There is no relation between transpiration and sensitivity, while any factor affecting the cuticular openings influences the extent of the damage. Resistance to smoke cannot be improved in forests by means of fertilizers. Different resistances of various species and individual trees as well as problems of breeding smoke-resistant species are discussed.

39493

Blakemore, F.

INDUSTRIAL FLUOROSIS OF ANIMALS IN ENGLAND. Proc. Nutr. Soc., vol. 1:211-215, 1944. 6 refs.

Industrial fluorosis was studied in stock in pastures near certain brickworks in England. The sources of fluorine was determined from the examination of the flue gases, detection of fluorine in the atmosphere, and evidence of surface contamination of plants. The severity of the symptoms depended upon the degree to which the herbage was contaminated. The chief sympton of severely affected cattle was lameness. The main histological features were extensive atrophy of the bony tissue and the presence of excessive amounts of asteoid. The fluorine content of the bones ranged within 6000-16,000 ppm. The amount of fluorine in the urine was most valuable in assessing damages.

39537

Wislicenus, H.

THE ASSESSMENT AND CONTROL OF SMOKE DAMAGE. (Zur Beurtheilung und Abwehr von Rauchschaeden). Text in German. Z. Angew. Chem (Weinheim), 14(28):689-716, 1901. 16 refs.

The assessment of smoke damage in a given case involves the gathering of evidence that the damage has indeed been caused by smoke, the rendering of proof of such damage, evaluation of its extent, and the estimation of damage for purposes of indexing. A methodology of smoke damage assessment on crops must include examination of the spot, consideration of other contributory factors (frost, mismanagement), laboratory tests, differentiation between acute and chronic damage, determination of the contributory share of several pollution sources, and the calculation of the actual damage accrued. Normal and abnormally high concentrations of pollutants (carbon monoxide, sulfur dioxide and trioxide, hydrogen chloride and fluoride, chlorine, carbon disulfide, cyanide, ether, gasoline vapors, hydrogen sulfide, and ammonia) in emissions from acid manufacturing plants, glass works, lime kilns, fertilizer plants, brick kilns, ceramic works, paper mills, dye works, sugar mills, the manufacture of explosives, and from railroad locomotives are tabulated, and the physiological effects of the various pollutants on plant tissues, on chlorophyll formation, and on assimilation in crops, deciduous trees, and conifers, and sampling and the analytical detection of sulfur and of fluorine in the samples are reviewed. One way of controlling smoke damage is to desulfurize coal by coking and to recover the sulfur by washing coking gas in an alkaline bath. Another way is to achieve a greater dispersion of emissions in the atmosphere by modifications in furnace and smokestack construction.

39607

Cristiani, H. and R. Gautier

CHRONIC FLUORINE POISONING FROM FOOD. (Intoxication chronique d origine alimentaire par le fluor). Text in French. Compt. Rend Soc. Biol. (Paris), 1925:139-141, 1925. 1 ref.

Studies on the toxic action of fluorine contaminated feed on domestic animals are reviewed. Chronic intoxication of cattle raised in fluorine-emitting industrial areas were mistaken for osteomalacia due to spontaneous fractures. The symptoms also persisted with balanced feed. Consequently, the symptoms were caused by fluorine instead of by deficiency of minerals. Fluorine contents above normal were revealed in the bones of cattle poisoned by fluorine. Fluorosis and fluorine cachexia occurring in fluorine-emitting industrial areas could be simulated by means of experimental doses. Minimum doses are required to cause toxic effects, and the time required for the development of cachexia is in proportion to the amount of the doses. Depending on the dose, times of a few weeks or months are required for lethal cachexia to occur. Fluorine concentrations of 1/1000 to 1/10,000 in hay are capable of producing death within a couple of weeks or months.

39627

Sette, Nicola

NOTE ON FLUOROSIS. (Note sur la fluorose). Text in French. Compt. Rend. Soc. Biol. (Paris), no. 98:1094-1096, 1928.

Symptoms of fluorosis, observed on bovine animals raised in a superphosphate manufacturing plant area, were simulated on guinea pigs. Also sulfuric and nitric acids were produced at this plant. The symptoms were most serious in cattle kept in a stable near the superphosphate store. The guinea pigs fed with the same feed as the cattle died in an interval of 20-50 days after the start of the treatment. The investigations revealed brittle bones, intense congestion in liver, kidney, and adrenal glands, as well as increased volume of the latter. The lesions were primarily characteristic of intense liver congestion. Single inflamed mononuclear cells with congestion and hemorrhagic suffusions were found. The symptoms observed were primarily caused by vapors of sulfuric and nitric acids rather than by fluorine. The bone lesions represented one of the symptoms of acid poisoning only and not the disease proper.

39684

Plagnat, Francois

MISTLETOE, INDUSTRIAL FUMES AND THE MAURIENNE FORESTS (SAVOIE). (Gui, fumees industrielles et forets de Maurienne (Savoie)). Text in French. Rev. Geog. Alp., no. 59:326-342, 1971. 23 refs.

Attention is drawn to the dramatic situation of the fluorine-damaged Maurienne forests. The first damage of these mistletoe forests, consisting of 90% coniferous trees, were observed in 1910 when nearby aluminum production started. The upper limit of the fluorine damage rose successively to altitudes of 1600 and 2200 m, while the attack of mistletoe was unimporant above 1000- 1400 m. Now, a forest area of nearly 10,000 ha is affected. The damage caused to mistletoe aggravated by the severe damage due to hydrofluoric acid. The losses due to smoke damage show an increase of 58% in the period 1956-1968, compared to the period 1950-1955. At the same time, production by the nearby aluminum plants increased from 43,000 t/yr in 1954 to 92,000 t/yr. The total fluorine emission is 1820 t/yr. Gas cleaning should be introduced. Irrespective of such steps, however, experiments are being carried out with American smoke-resistant Thuya plicata in a 75 ha-area. Measures by the newly-established Department of Environmental Protection are anticipated.

39782

Haut, H. van

EXPOSURE CHAMBER PROCEDURES IN THE DETECTION OF PHYTOTOXIC POLLUTANT COMPONENTS. (Testkammerverfahren zum nachweis phytotoxischer Immissionskomponenten). Text in German. Environ. Pollut., 3(2):123-132, April 1972. 12 refs.

Portable exposure chambers were developed to identify the presence of phytotoxicants in the air, particularly in areas with several pollutants, by plant reactions to filtered and unfiltered air. An experimental unit includes two chambers, each consisting of a plexiglass cap covering the plants to be exposed and a box below containing air filter, blower, and watering system. Ambient air is filtered before entering the control chamber or is passed directly into the experimental chamber. By comparing the plant reactions in both chambers, the effects of the pollutants are accurately identified; combinations of indicator plants with differing resistance levels and special filtering systems determine the individual pollutants. A filter material coated with silver and silver oxide is used to remove the most important phytotoxicants, i.e., sulfur dioxide, hydrogen fluoride, and hydrogen chloride. The exposure chambers can be used for fumigation experiments in the field and in climatic chambers and for the testing of pesticides.

39887

Sertz, H.

ON THE EFFECTS OF HYDROFLUORIC ACID AND FLUOSILICATE ON LIVING PLANTS. (Ueber die Wirkung von Fluorwasserstoff und Fluorsilizium auf die lebende Pflanze). Text in German. Tharandter Forstl. Jahrb., vol 72:1-13, 1921.

Smokebox tests were carried out on fir and spruce trees to investigate the effects of hydrofluoric acid and fluosilicate in two different concentrations. Both types of trees showed signs of acute poisoning from tests where smoke with a concentration of 1:10,000 of either compound was applied for 1 hr each day. In another test, where the trees were treated with a concentration of 1:250,000 of either compound for three 1-hr periods per day to indicate chronic effects, firs showed higher resistance to fluor than did spruces. Hydrofluoric acid and fluosilicate are extremely harmful to living plants even in very low concentrations. Damage symptoms are similar to those observed in sulfurous acid tests. The material damaged by smoke was analyzed for fluor content.

39895

Slagsvold, Lars

FLUORINE POISONING. (Fluorforgiftning.) Text in Norwegian. Nord. Veterinaermed., vol. 36:2-16, 1934.

Investigations were carried out into possible connections between disease symptoms occurring in domestic animals and fluorine air pollutants from nearby aluminum plants. Dust samples from the aluminum works area contained 14.05% fluorine and 25% fluorides (cryolite, magnesium fluoride, aluminum fluoride). Feed experiments were performed on domestic animals with small doses of cryolite and sodium fluoride (1 g each daily). The animals showed signs of fluorosis (exostosis, weight loss, anemia, paralysis, irritations or inflammations in digestive organs, drop in red blood cells, lachrymation, bone porosity or brittleness). Symptoms observed in the experimental animals were similar to those of animals who became sick under natural conditions. Ashed bone samples of poisoned

animals contained fluorine, with levels in teeth always lower than in bones. Bone was the most affected of all tissue. The effect of fluorine compounds rises with increasing solubility.

39902

Bursche, Eva-Maria

VEGETATION DAMAGE BY FLUORINE. (Vegetationsschaeden durch Fluor). Text in German. Schriftenreihe Ver. Wasser Boden Lufthyg. (Berlin), no. 10:39-83, 1955. 43 refs.

Laboratory tests were carried out to elaborate methods for recognizing and diagnosing plant damage produced by fluorine smoke. Brown to black ends and discolored edges were observed on leaves from open-air and artificially smoke-exposed plants. The resistances of different plants were investigated. Microscopic observations revealed slightly creased epidermis and badly creased parenchyma. The cell content formed a homogeneous brown mass in badly damaged leaves. Coloration due to fluorine and natural processes were separated in tissue investigations. Plasmolytic experiments were carried out for diagnosing chronic, acute, and invisible damage with NaF and NaCl. In Fontinalis antipyretica, 0.03% NaF-solution constituted the threshold limit while NaCl was much less harmful. No influence of the toxic effects of NaF and NaCl on the rate of plasmolysis could be revealed. Cells damaged by NaF (separation of protoplasts from the cell walls and slight plasmolysis) were regenerated after the normal conditions were restored. Hydrofluoric acid was more harmful than sodium fluoride. Elodea densa was damaged by a 0.0008% hydrofluoric acid solution. A special spectrophotometric method that permits determination of a typical acid effect only is explained. Chlorophyll extracts from damaged leaves showed a band of 535 micromicron, of different intensities depending on the actual fluorine content. Experiments were carried out to detect fluorine in plants by means of the methemoglobin method. A minimum of 0.01% of NaF in pure NaF solution could be satisfactorily detected. The method for dissolving the leaf material for fluorine detection is not sensitive enough. The characteristic fluorine-methemoglobin-hemoglobin band could be obtained for leaf material artificially damaged by 40%-HF, and ashed.

39923

Stas, M. E.

FLUORIDE POSIONING DUE TO EXHAUST GASES AND DEPOSITS FROM A SUPERPHOSPHATE FACTORY. (Fluoor-vergiftiging door rookgassen en stof van een superphosphaatfabriek). Text in Dutch. Chem. Weekblad, no. 38:585-593, 1941. 101 refs.

Fluoride poisoning of cows, caused by emissions from a superphosphate factory, was investigated. Fluoride levels in bones were determined by quantitative methods, and the fluoride contents of rain and sluice water were measured. A method of sample preparation is described, and measured values of bone ash from different cities are tabulated. Results indicate that the affected animals were exposed to soluble fluoride in sluice water and to large quantities of fluoride in gases and hay fodder. Fluoride poisoning in humans, experiments on damaging effects to plants and animals, and problems of quantitative determination are discussed, and a literature survey of fluoride toxicity in cows is included.

39932

Schmitz-Dumont, W.

TESTS ON THE EFFECTS OF ATMOSPHERIC HYDROFLUORIC ACID ON PLANTS. (Versuche ueber die Einwirkung von Fluorwasserstoff in der Atmosphaere auf Pflanzen). Text in German. Tharandter Forstl. Jahr., vol. 46:50-57., 1896.

Smokebox tests were carried out on 3-year-old trees to investigate the effects of hydrofluoric acid introduced in the form of NaHF in two different concentrations. Smoke was applied once a day. At a concentration of 1:10,000, spruce showed a much lower resistance than oak, the most resistant, and Norway maple. Ashes from oak leaves treated with hydrofluoric acid gas outdoors contained 0.125% fluor while those from untreated leaves were free of fluor. Applications of smoke with hydrofluoric acid in a concentration of 1:300,000 revealed the harmfulness of this substance to plants, even in this low concentration, when the exposure is for a period. Oak and Norway maple again showed higher resistance than spruce case. Brown and red discoloration of the leaves and needles are the most conspicuous symptoms of fluorine damage.

39986

Schneider, R. E. and D. C. MacLean

RELATIVE SUSCEPTIBILITY OF SEVEN GRAIN SORGHUM HYBRIDS TO HYDROGEN FLUORIDE. Contrib. Boyce Thompson Inst., vol. 24:241- 243, 1970. 4 refs.

The relative susceptibility to gaseous hydrogen fluoride of seven grain sorghum hybrids of commercial importance in Texas was investigated. Fumigation resulted in necrosis of the leaf tips and chlorotic mottle of subtending tissue. Necrosis was generally limited to the second and third youngest leaves. The severity of injury was variable: DeKalb C44C and RS 608 were most resistant to HF-induced necrosis and Northrup King 222A, Pioneer 846, RS 610, RS 625, and RS 671 were more susceptible. There was no relationship between foliar injury and F accumulation. (Author abstract modified)

40201

Huffman, W. T.

EFFECTS ON LIVESTOCK OF AIR CONTAMINATION CAUSED BY FLUORIDE FUMES. Interdepartmental Committee on Air Pollution, Washington, D. C., Air Pollut., Proc. U. S. Tech. Conf., Washington, D. C., 1950, p. 59-63. 16 refs. (May 3-5, Louis C. McCabe, ed.)

Chronic fluorine toxicosis in livestock can be caused by aerial contamination of forage with fluorine effluents from nearby industry, principally phosphate and aluminum processing plants, although cement plants and enameling works may also be involved. The extent of the area involved is governed by the volume of fluoride effluents, the form in which they occur, and meteorologic factors. Effects on livestock depend on the level of intake, duration of the feeding period, the class of animals involved, and feeding and management practices. The symptomatology is described; dental fluorosis and bone lesions are prominent. Normal and threshold levels of fluorine in bone tissue and normal and excess urinary levels are noted. Dairy cattle appear more susceptible to fluorosis than beef breeds, but neither meat nor milk from affected animals is likely to be injurious. Complicating factors unrelated to fluorosis should be considered, since most of the symptoms may be present in a variety of diseases. Disease control requires reduction of emissions to the point where nearby forage contains a safe level of fluoride.

40202

Zimmerman, Percy W.

EFFECTS ON PLANTS OF IMPURITIES ASSOCIATED WITH AIR POLLUTION. Interdepartmental Committee on Air

Pollution, Washington, D. C., Air Pollut., Proc. U. S. Tech. Conf., Washington, D. C., 1950, p. 127-139. 30 refs. (May 3-5, Louis C. McCabe, ed.)

Studies of the effects of low concentrations (0.1-0.2 ppm) of sulfur dioxide on alfalfa under different conditions of temperature, water, and nutrient supply; sulfur content of nutrients; and age of plants showed that resistance to SO2 at 40 F or below is greater than at higher temperatures. Drying the soil to a point that causes wilting also increases resistance to the gas. Plants tend to recover between treatments if enough time elapses. Plant susceptiblity during treatment increases with light up to full sunlight. Young plants are more resistant than old plants, while middle-aged leaves are most susceptible. The susceptibility of various species and the characteristic symptomatology are described. The results of experimental famigations of plants with 0.05 to several ppm hydrofluoric acid gas in air are detailed, and similar studies of the effects of chlorine, hydrogen sulfide, ammonia, mercury vapor ethylene and carbon monoxide, and the vapors of 2,4- dichlorophenoxyacetic acid and other hormone-like herbicides are reported.

40341

Grzywacz, Andrzej

THE INFLUENCE OF INDUSTRIAL AIR POLLUTION ON PATHOLOGICAL FUNGI OF FOREST TREES. (Wplyw przemyslowych zanieczyszczen powietrza na grzyby chorobotworcze drzew lesnych). Sylwan, 15(6):55-62, 1971. 28 refs. Translated from Polish. Scientific Translation Service, Inc., Santa Barbara, Calif., 13p.

The reaction of pathological fungi to the presence of air pollution is a function of the chemical nature of the pollutants, their concentration, the frequency of diurnal and seasonal changes in concentration, the duration of action, the composition of floras, the degree of damage by phytotoxins in the pollutants, the topography of the terrain, climatic conditions, the character of the forest site, and the sensitivity of the pathogens. The most important pollutants and their sources are reviewed, including sulfur dioxide, fluorine compounds, smog, and ozone formed from nitrogen oxides. The toxic action of SO2 with respect to fungi depends on the temperature and relative humidity of the air, increasing with an increase in relative humidity. The occurrence of pathological fungi in forests with polluted air, the effect of air pollution on certain vital processes of fungi, and the mechanism of action of the air pollutants on the fungi are considered.

40368

Zuber, Roberto

NEW TASK FOR THE RESEARCH INSTITUTE: ENVIRONMENTAL HYGIENE. (Neuer Aufgabenbereich der Forschungsanstalt: Umwelthygiene). Text in German. Chem. Rundschau (Solothurn), 25(16):450, April 1972.

A new department for environmental hygiene of the Swiss Research Institute for Agricultural Chemistry deals with health aspects of air pollutants on domestic animals with the effects of air pollutants on agricultural crops. The department tests the fodder, plants, fruits, as well as bones, and urine of animals from the vicinity of fluorine emitting industries as to the fluorine concentration. In all cases the method with the ion specific fluoride electrode was found most suitable for the analyses. Measurements of the lead concentration along street and highways by atomic anstorption spectrophotometry revealed that plants and grass carried lead concentrations of up to 170 ppm 1-3 m from the street curb. They decrease slowly to a distance of about 50 m. In some cases lead residues were still measured as far off as 100 to 200 m. The various types of plants accumulate the lead in different ways. Rain and tap water wash out the metal to half of the original concentration. The sulfur dioxide concentration of the air is presently being determined by the Ultragas unit. Measurements of other pollutants such as ammonia, chlorine, the oxides of nitrogen, dust, unburned hydrocarbons, oil, rubber, and asbestos shall be the target of future studies.

40460

Schnetzer, H. -L. and Wenger, H.

VEGETATION TESTS AND ANALYTICAL WORK IN THE LABORATORIES. (Vegetationsversuche und analytische Arbeit in den Laboratorien). Text in German. Chem. Rundschau (Solothurn), 25(15):425-427, April 1972.

Since the important quantities of refuse from mass-stock farming and the various types of sludges are reused in Swiss agriculture, vegetation tests were carried out by the Swiss center for agricultural chemics in order to examine the compatibility of the matter used as manure. Vegetation tests were also done to investigate the influence of exhaust gases from motor cars, fluoride, and sulfur trioxide on plants. The Swiss research center used an air-conditioned vegetation hall where the tests were made during the whole year. The necessary sun light was simulated by fluorescent strip lamps of 20,000 Lux. Plants to be tested were put into special zinc pots filled with 5 l of mineral soil and were exposed.

40472

Neustein, S. A., and N. P. Danby

POTENTIAL ATMOSPHERIC POLLUTION FROM THE INVERGORDON INDUSTRIAL COMPLEX. Scot. Forest., vol. 24:270-273, Nov. 1971. 5 refs.

The main atmospheric pollutants from the Invergordon complex will be fluorine and hydrogen fluoride from the aluminum smelter and sulfur dioxide and hydrocarbons from the oil refinery. Both acute and chronic tree damage is expected. The effects of F and SO2 on the trees via the soil is expected to be insignificant. Acute tree damage results from high concentrations of pollutants as a result of meteorological conditions or industrial cleansing failure. Chronic tree damage results from long term low level pollution. Broad leaved trees are not regarded as susceptible to chronic pollution. All the conifers are susceptible. Clean air sampling has begun in order to provide before and after comparison. Foliage samples will be taken for a radius of 16,000 M. A survey of lichens has been completed. Lichenology may assist in discrimination between F and SO2 injuries.

40599

Cristiani, H.

FLUORINE EMISSIONS OF INDUSTRIAL ORIGIN. EFFECT OF FLUORINE ON PLANTS AND ANIMALS. (Emanations fluorees d origine industrielle. Action du fluor sur les plantes et les animaux). Text in French. Chim. Ind. (Paris), vol. 17:158-168, May 1927. (Presented at the Congress de Chimie Industriel, 6th, 1926.)

Shrinkage and drooping of cress plants and grass, and lesions in dandelion leaves, caused by a 1-hr exposure to fluorine vapors in a test chamber are described. In the vicinity of an aluminum plant, where the electrolytic bath is composed of cryolite, a sodium- aluminum fluoride, vegetables and the leaves of fruit trees show signs of burning and great damage can be observed on forest trees. Animals are affected by fluorine through their fodder. Guinea-pigs fed plant food ex-

posed to hydrofluoric acid gases develop fluorosis, but with very small concentrations, death may occur only after a year or more. Cows afflicted with this disease due to fodder harvested in fluorine-infested areas show initial symptoms of lameness of one or more legs, stamping by the animal, resting on one leg and then the other, inability to rise, and spontaneous sprains and bone fractures occurring in the stable. After several months, the animal gradually grows thin with a dry, hard hide and eventually dies. Experiments with corpses of animals who died of fluorosis have shown that their bones are more brittle than those of normal healthy animals.

40899

Kuribaya Shigeharu, Masaya Kadota, and Kisabu Yatomi

EFFECTS OF ATMOSPHERIC FLUORIDE AND SULFUR DIOXIDE ON SERICULTURE. (Fukka sulso oyobi nisanka io no kuwa oyobi kaiko ni oyobosu eikyo). Text in Japanese. Taiki Osen kenkyu (J. Japan. Soc. Air Pollution), 6(1):155, 1971. (Presented at the National Council Meeting of Air Pollution Studies, 12th, Nagoya, Japan, Oct. 27-29, 1971.)

The effects of hydrogen fluoride and sulfur dioxide on mulberry and, subsequently, on silkworm administered with the mulberry leaves were studied. Potted plants of mulberry were placed in a gas contact chamber for 4-72 hours in a hydrogen fluoride atmosphere of 30 ppb or for 2-8 hours at 200 ppb, and in sulfur dioxide atmosphere of 2 ppm for 8-72 hours. The silkworms were administered with the leaves continuously for the three stages of growing. From about 1/4 hours in 0.03 ppm HF or 2 hours in 0.2 ppm, the external appearances of the leaves started to show discoloration, and approximately 120 to 160 ppm HF were accumulated on the leaves. Silkworms administered mulberry leaves containing 35 to 70 ppm HF showed chronic symptoms such as malacosis, and died with leaves containing more than 90 ppm HF. Two ppm of SO2 for 72 hours caused spot browning of the leaves, and 0.8% of the SO2 was accumulated. Silkworms administered with the leaves died from loss of appetite, malacosis.

40916

Gruender, H. D.

PREVENTION OR REDUCTION OF FLUORIDE EFFECTS IN CATTLE. Fluoride, 5(2):74-81, April 28, 1972. 6 refs. (Presented at the International Society for Fluoride Research, Annual Conference, 4th, the Hague, Netherlands, Oct. 24-27, 1971.)

Fluoride uptake in plants, animals, and humans is determined by the sum total of fluoride in the soil, water, and air due to both natural and emission sources. To prevent or reduce the damaging effects of fluoride on cattle, in particular, the maximum emission concentration must be limited to 1 microgram/cu m of air to be further supplemented by a reduction in the daily fluoride uptake by animals from feed below the tolerance limit; a limitation of the period of emission; and inhibition of the rate of fluoride absorption into the animal tissue. Based on studies in two emission areas, methods concerning the production, maintenance, and feeding technique are suggested. A supplementary feeding regime with a low fluoride forage (below 20 ppm) will reduce the daily fluoride uptake per kilogram of dry food substance on an average by 8%. During a two year experiment on 24 milk cows in a polluted area near an aluminum factory, administration of a low fluoride food mixture containing 3% aluminum sulfate and chloride in equal parts reduced fluoride uptake and absorption per kilogram dry substance by about 15%. (Author summary modified)

41189

Piskornik, Zdzislaw and Stefan Godzik

EFFECT OF AIR POLLUTION ON PLANTS. (Oddzialywanie zanieczyszczen powietrza na rosliny). Text in Polish. Wiad. Bot., 14(2):91-102, 1970. 157 refs.

Some aspects of sensitivity of plants of phytotoxic agents (sulfur dioxide, fluorine and chlorine compounds, ozone, pollutants of an oxidative character) and of the changes in intensity of vital plant processes are discussed. Discussion is based on literature documentation. The role of ecological factors (atmospheric and soil humidity, sun-light conditions, temperature, and content of minerals in soil) in modification of susceptibility of plants to phytotoxic pollution of the atmosphere and in modification of effect of these pollutants on biological processes in plants is shown. The age of foliage also modifies in plant sensitivity to pollution with foliage on middle age being most sensitive. Some gaseous phytotoxic compounds accumulate in leaf cells (SO2, fluorine and chlorine compounds). The changes in intensity of plant physiological processsss, especially in photosynthesis, are a measurable and sensitive indicator of plant reaction of pollution. The disturbances in enzymatic processes, i.e., changes in activity of a number of enzymes caused by SO2, ozone, fluorine compounds, and substances of photochemical origin, are discussed.

41362

Haut, H. van

THE ACTION OF AIR POLLUTANTS ON PLANTS. (Wirkungen von Luftverunreinigungen auf Pflanzen). Text in German. In: Ullmanns Encyklopaedie der Technischen Chemie. Vol. 2/2, 3rd ed., Berlin, Urban and Schwarzenberg, 1968, p. 349-356. 9 refs.

Sulfur dioxide and hydrogen fluoride are the main industrial pollutants causing widespread damage to plants; nitrogen oxides, ammonia, hydrogen sulfide, chlorine or hydrochloric acid, bromine, and iodine produce effects limited to the industrial area. Hydrophyle mineral acid vapors such as sulfuric or nitric acid exhibit their action within the area close to the emission source. Depending on the concentration of pollutants and on the duration of their action, plant damage can be acute, chronic, or latent. Acute damage is produced by high air pollutant concentration following short-time exposure; leaf necrosis, general weakening of plant vitality, reduced growth, and sometimes plant death are its main effects. Chronic plant damage occurs in areas exposed to long- lasting low pollutant concentrations and includes chloroplast damage associated with inhibition of photosynthesis and overall impairment of metabolism. Latent damage is considered a precursor of chronic damage. Alterations of the structure, pH, and nutritional quality of soil from the cumulative action of pollutants cause indirect damage to plants. Diagnosis of plant damage from air pollutants can be made visually, by chemical analysis of air and plant samples, and by biological tests. Experimental evaluation of pollutant action on plants in special exposure chambers or in the free field should constitute one of the basic tools of research in this field. Inlcuded are descriptions of such experimental facilities are described and prevention of plant damage from pollutants by special soil treatments is discussed.

41370

Stefan, K.

THE VALUE OF AIR AND NEEDLE ANALYSES FOR SMOKE DAMAGE DETERMINATION. (Der Wert von Luft- und Nadelanalysen fuer die Rauchschadensfeststellung). Text in

German. Mitt. Forst. Bundesvers., no. 73:91-99, 1966. 9 refs. (Presented at the Symposium on Smoke Damage to Forests in Austria, Vienna, Austria, Nov. 9-11, 1965.)

For air analyses, quantitative and qualitative long-term methods, rapid methods, continuous and intermittent, and recording methods can be applied. Qualitative long-term analysis does not reveal the actual time the emission occurred and the frequency of toxic concentrations. The rapid and recording methods deliver data on the absolute concentration and the frequency of toxic concentrations. The latter methods should, however, be preceded by a general survey, applying long-term methods. Formulae for determining stack height only apply to plain areas with no forests. Threshold values cannot be regarded as fully reliable. The threshold of 0.5 mg/cu m for sulfur dioxide may be too high for certain plants. For sulfur dioxide, leaf analyses are not fully reliable due to the inherent SO2 content and the lack of a direct relationship between emission intensity and leaf SO2. Fluorine analyses yield, however, unambiguous results. The samplings should be completed within a relatively short period, and in the same vegetation periods for analyses extending over a number of years. Due to different sensitivities and influencing factors, the intensity of the damage cannot be determined from SO2 and fluorine analyses. Consequently, representative forest age and comparable test areas are principal sampling criteria. While air and needle analyses unambiguously reveal the fact of emission, the actual damage can only be determined from growth measurements.

41439

Daessler, H. G.

THE EFFECT OF HYDROGEN FLUORIDE AND CRYOLITE DUST UPON PLANTS AND ANIMALS NEAR A HYDROGEN FLUORIDE FACTORY. Fluoride, 4(1):21-24, Jan. 1971. 3 refs. (Presented at the International Society for Fluoride Research, Annual Conference, 3rd, Vienna, Austria, March 22-25, 1970.)

Some of the findings obtained from 11 test stations situated near a hydrofluoric acid factory are reviewed. Studies were conducted on forestry, agricultural, and horticultural plantings in the emission area. In the immediate vicinity of the factory, HF induced necrotic lesions on vegetation and fluoride accumulation in the foilage of fruit trees. The leaves of fruit trees showed necroses on the side of the plants facing the factory. The margins of leafy plants reached fluoride values of up to 80 mg in dry, hot weather. At a 6 km distance, necrotic areas were found on fruit without visible damage to the foilage, particularly in pears, sweet cherries, apples, plums, and tomatoes. Fruit development decreased when HF levels were high at blossoming time. Only the fruit of pears is sensitive; the leaves and fruit of plums are equally susceptible to damage. Resistant plants include sour cherries, winter rape, sugar beets, potatoes, cabbage, asters, and roses. Results of fumigation experiments showed that although most evergreens, walnut, and maple trees should not be considered for cultivation near fluoride pollution, field corn, common oak, and lilac can be planted. Forage near the factory contained 76-120 mg fluoride/100. This caused reduced milk production, yellow stains on teeth, motor disorders, and bone changes in dairy cows. Bee populations were also affected. A decrease in fluoride pollution was accomplished by the installation of control equipment.

41482

Pfeffer, Anton

INSECT PESTS ON FIRS IN AIR POLLUTION AREAS. (Insektenschaedlinge an Tannen im Bereich der Gasexhalationen). Z. Angew. Entomol., vol. 51:203-207, 1962/1963. 9 refs. Translated from German. Scientific Translation Service, Inc., Santa Barbara, Calif., 7p.

The effect of fluorine emitted into the air on insect pests in fir groves was investigated in center Czechoslovakia. Before the first signs of injuries, an attack of dark beetles often appeared along with occasional snout beetles. Weak damage from the larvae of the fir leaf roller could also be observed. The fir bark lice appeared only in isolated instances. In the course of several years, the fir trees slowly sickened and died. Primary monophagous bark beetles of the genus Pityokteines Fuchs disappeared. Only small numbers of Pissodes piceae Ill. and the bark beetle species living in twigs (Cryphalus piceae Rtzh., Cryphalus abietis Rtzb., and Pityophthorus pityographus Rtzb.) were observed. In contrast, Dreyfusia piceae Rtzb., Dreyfusia nuesslini C.B., and the polyphagous wood wasp living in the wood (Paururus juvencus L.) increased in population. (Author summary modified)

41696

Zieger, Erich

SMOKE-INDUCED DAMAGE TO FORESTS. (Rauchschaeden im Walde). Text in German. Wiss. Z. Tech. Hochsch. Dresden, 3(2):271-280, 1953- 1954. 22 refs.

Problems of smoke-induced damages and appropriate control measures are reviewed. Fly ash and waste gases are the pollutants involved in forest damages. Fly ash depositing chiefly in zones of 100-600 m around high stacks turns the soil gradually sandy. Sulfur dioxide is the most dangerous of all waste gases, followed by sulfuric acid, hydrofluoric acid, nitric acid, fluorine compounds, ammonia, hydrogen sulfide, and tar vapors. Both the character and the measure of the damages are determined by such factors as distance from the emission source, dilution, and season. Regarding damages due to etching, different species show different degrees of resistance, conifers being highly sensitive. Damages due to disturbed assimilation are most important in humid weather and in old needles. The sensitivity increases with increased assimilation activity. The incrustation damages caused by dust build-up on leaves and needles are of a local character. The pollutants also affect the soil, turning it acid, and changing its physical and chemical properties. The control measures should be applied at the emission source proper. The fine fractions of the fly ash, amounting to 50-75%, are hard to retain, and high stacks cannot be regarded as an adequate solution. Various methods of dust separation are discussed. There are no adequate methods for sulfur dioxide control available. The breeding of smoke-resistant stands, the plantation of shelter woods, and liming are some of the steps to be taken by forestry.

41698

Wentzel, K. F.

METHODS IN TREATING FOREST IMMISSION DAMAGES IN GERMANY. (Erfahrungen bei der Bearbeitung forstlicher Immissionsschaeden in Deutschland). Text in German. Mitt. Forst. Bundesvers., no. 73:237-247, 1966. (Presented at Symposium on Smoke Damage to Forests in Austria, Vienna, Austria, Nov. 9-11, 1965.)

Problems and experiences regarding emission damages are outlined. Following World War II, increased growth was observed in coniferous forests damaged fomerly by emissions. Domestic heating and traffic have no negative effects on forests, but changeovers to central heating stations may cause damages. In coniferous forests in highly industrialized areas, sulfur dioxide concentrations exceeded a threshold of 0.5 mg/cu m in 6% and

less than 1% of the winter and summer seasons, respectively. Leaf and needle analyses are the best method to determine damages, as air analyses have indicative character only. Needle analyses deliver more reliable data than leaf analyses for SO2 and HF. Two year old needles are best for analyses. Rates of growth should be measured in vertical rather than radial direction, as vertical growth is most affected by emissions. The test plant methods have no value for forestry, while test trees can be used to evaluate damages to arm plants. Emission damages should be prevented at their sources, i.e., in industry, by using effective pollution control techniques or less harmful raw materials. Increased stack heights can enlarge the emission-affected area, particularly in hilly regions. In industrialized areas with high emissions, forest maintenance costs rise, and an increasing number of forest properties are sold as a consequence.

41699

Huber, H.

EFFECT OF AIR POLLUTION ON PLANTS. (Ueber die Einwirkung von Luftverunreiningungen auf die Pflanzen). Text in German. Mitt. Schweiz. Landwirtsch., 19(1):7-18, Jan. 1971. 1 ref.

Effects of different air pollutants on plants are described, with special regard to sulfur dioxide and fluorine. Daily averages of 0.2 cu cm and 0.3 cu cm SO2 are specified for summer and winter seasons, respectively. After attacking the chlorophylls, sulfur dioxide is metabolized into sulfates and other compounds in plants. Lasting exposures to low concentrations are less harmful than limited exposures to high concentrations. Different species and plant parts show different degrees of resistivity to SO2. Young plants and coniferous trees are most sensitive. Blossoms are less sensitive than green parts. Fluorine concentrations of 0.005-0.018 ppm were measured in industrial areas in Switzerland. Though a threshold of 0.01 ppm/cu m is specified, necrosis can be observed at concentrations of 0.0001 mg/cu m in certain species. Concentrations of 0.003-0.004 mg/cu m result in reduced crops. The toxic effects of fluorine compounds are dependent of their respective solubilities. Fluorine attacks auxins, and inhibits both assimilation and respiration processes. Both high relative humidity and temperature, and nitrogen shortage enhance hazards. Old needles show decreased susceptibility. Different species show different rates of absorption for fluorine. Pale green of yellowish coloration and peripheral necrosis of leaves and needles are conspicuous symptoms of fluorine-induced damage. Other air pollutants exercise mostly local and transitory effects. Chlorine and hydrochloric acid lead to total necrosis, while hydrogen sulfide is harmful in high concentrations only. The effects of metals, metallic oxides, metalloid anhydrides, dust, and tar vapors are not negligible. Lead compounds in exhaust gases are very harmful, partucularly for vegetables for human consumption. Ethylene is harmful in a concentration of 0.01 ppm. Among photochemical oxidants, ozone and peroxyacetyl nitrates as found in smog are highly phytotoxic. Spinach, tobacco, tomatoe, and cereals show increased sensitivity against ozone.

41904

Maeno, M.

EFFECTS OF AIR POLLUTION ON TREES (IX) FLUORINE IN LEAVES OF STREET TREE. (Jumoku ni taisuru taiki osen no eikyo (Daikyuho) Gairo juyo no fusso kanryo). Text in Japanese. Taiki Osen Kenkyu (J. Japan Soc. Air Pollution), 6(1):154, 1971. (Presented at the National Council Meeting of Air Pollution Studies, 12th, Nagoya, Japan, Oct. 27-29, 1971.)

The fluoride contents of street trees in various areas were studied. Fluorines were mainly discharged as hydrogen fluoride and silicon tetrafluoride. The tolerance threshold of plants to fluorides was as low as 1-10% of tolerance to sulfur dioxide. Fluoride content in leaves of paulownia sampled in May 1967 was highest value at 1600 ppm and averaged at 409 ppm. The average concentration in leaves of the maidenhair tree was 193 ppm; that of the willow was 97 ppm. Average concentrations in leaves of trees in commercial and residential areas were as low as 10-30% of concentrations in industrial areas. Fluoride concentration slightly increased in the residential area from 1967 10 1970 but remained unchanged in commercial areas and decreased in industrial areas. High fluoride content was also measured in the soil of industrial areas.

41983

Maeno, Michio

ATMOSPHERIC POLLUTION AND BOTANICAL GROUP GROWING. (Taikiosen to Shokubutsu Gunraku). Text in Japanese. Kankocho Kogaisenmon Shiryo Public Nuisance Gaz.), no. 3:58-64, April 1972.

A botanical index for the evaluation of atmospheric pollution is examined. Plants can be affected by sulfur dioxide, fluorides, chlorine, nitrogen oxides, ozone, hydrogen sulfide, ethylene, dust, and peroxyacetyl nitrate. Type of damage in plants depends on the difference in pollutants. The Science and Technology Agency has investigated four kinds of deciduous trees and five kinds of evergreens. The period of the investigation was from last part of July to last part of August, and for the investigation of defoliation, after the first part of October. Surveyed areas were six spots 2, 4, and 6 km to the west, 12 km to the west- northwest, and 12 and 25 km to the northwest of the seaboard industrial belt area. The relationship between distance from the industrial belt area and degree of damage is given. The relationship between concentration of sulfur oxides in the air according to the lead dioxide method and sulfur content in ginkgo leaves is a close correlative relationship. Use of the botanical index for evaluation of atmospheric pollution has a bright future, and in order to get the widely spread information, it is necessary to patternize and computerize the subjects of investigation. The specific gravity of each of the investigation items should be compared with the comprehensive plant vitality.

42086

Nakashima, Yasuhiro, Yukihiro Hagihara, and Seiji Ogawa

NOTES ON THE DUST DAMAGE OF TREE. (Jumoku to jinai ni kansuru shiken). Text in Japanese. Fukuoka-ken Ringyo Shikenjo Jiho, (Bull. Fukuoka-Ken Forest Expt. Station), no. 22:31-35, March 1972. 1 ref.

Sulfur dioxide, chlorine, and fluorine affect trees. Eleven kinds of young trees were planted in April 1969. The fly ash and cement dust were spread three times/month through 17 months on the trees of the test groups which were compared with the trees of control groups. There was no visible negative effect of the ash and the dust on the development of trees. The developmental index for each kind of the tree was measured and is shown on a graph. The pH of the soil of each group was measured and is shown on a table.

42601

Yamasaki, Yoshiaki and Toshio Hasegawa

INVESTIGATION OF AIR POLLUTION BY FLUORIDES (NO. 2). (Fukkabutsu ni yoru taiki osen chosa). Text in Japanese. Taiki Osen Kenkyu (J. Japan. Soc. Air Pollution),

4(1):148, 1969. (Presented at the Japan. Society of Air Pollution, Annual Meeting, 10th, Tokyo, Japan, 1969, Paper 146.)

A glass factory in East Osaka has a histroy of damaging agricultural produce in the area. A sodium hydroxide absorbent analysis of flue gas from the factory was conducted and a filter paper cylinder measurement of the concentration distribution was taken. Settling particulates were measured by a simple soot collection jar. Samplings of agricultural produce were burned to ashes and a perchloride analysis was given. The fluorine emission at the time of melting of raw material was 9.2 to 229.6 F mg/N cu m Hydrogen fluoride concentration near the furnace was 0.71 to 2.25 ppm. The maximum fluoride content in settling particulates near the boundaries of the factory premise was 1.54 F mg/sq m/day. This last figure was no higher than the average concentration of nonpolluted areas. The F concentration in the lee of the factory was higher than other directions, and this corresponded with the fact that the farms with produce damages were southwest of the factory, and that the wind was mainly northeasterly in this area. Heavily damaged leaves of rice and soybeans in these farms had several hundred times higher fluoride content than those in undamaged leaves.

42857

Nielsen, S. W.

ENVIRONMENTAL POLLUTANTS PATHOGENIC TO ANIMALS. J. Am. Vet. Med. Assoc., 159(9):1103-1107, Nov. 1, 1971.

Veterinary diagnostic laboratories have detected a number of disease problems caused by environmental pollution. The pollutants and the resulting disease conditions are in many forms. Air pollution due to industrial and automotive exhaust fumes causes damage to the lungs of man and lower animals that closely share his environment, namely, the dog and the cat. Lung lesions caused by prolonged fume or dust inhalation range from anthracosis, emphysema, and fibrosis to lung cancer. Dogs and cats in London have a much higher incidence of oro-pharyngeal cancers than in any other area in the world. Radioactive fallout from the testing of nuclear devices has caused chronic radiation dermatitis and precancerous lesions in cattle, mules, and other animals grazing near test sites. Fluorosis has been observed in cattle and deer on pastures surrounding factories processing clay or other raw products with high fluoride content. Other environmental pollutants which are toxic to animals include nerve gas, chlorinated hydrocarbons, polychlorinated biphenyls, lead, and mercury. Tasks for the veterinary pathologist with regard to the identification and examination of environmental compounds causing pathogenesis are outlined.

42907

Yu, Ming-Ho, Gene W. Miller, and C. James Lovelace

GAS CHROMATOGRAPHIC ANALYSIS OF FLUOROORGANIC ACIDS IN PLANTS AND ANIMAL TISSUE. International Union of Air Pollution Prevention Associations, Proc. Int. Clean Air Congr., 2nd, Washington, D. C., 1970, p. 156-158. 15 refs. (Dec. 6-11, Paper MB 4E.)

Studies to develop gas chromatographic techniques for the determination of organic, specifically fluoroorganic, acids in tissue, and to determine organic acid changes induced by fluoride injury are reported. A gas chromatograph was used with a flame ionization detector. Analyses were carried out on dual columns using helium carrier gas. Tissues were obtained from soybean plants fumigated with approximately 60 ppb of atmospheric hydrogen fluoride for 4 days. Leaves from soybean plants grown in a chamber fumigated with ambient air were used as controls. Kidneys and hearts from cows and horses suffering severe fluorosis were used in further studies. Results indicate that several organic acids and other volatile compounds in the fluoride treated tissue changed in concentrations compared to control tissue. Cis-aconitate, citrate, and oxalate were not determined. Malate, malonate, and succinate increased markedly in concentration when plants were exposed to hydrogen fluoride.

42923

EFFECT OF AIR POLLUTION ON VEGETATION. In: Air Pollution Manual. Part I. Evaluation. Detroit, American Industrial Hygiene Assoc., 1960, Chapt. 5, p. 49-61. 18 refs.

Local meteorology, industrial operations, type of fuel in general use, incinerator practice, motor fuel consumption, and other factors all contribute to the individual character and extent of the pollution produced and the resulting damage to vegetation. Gas exchange by the plant takes place largely by diffusion through the many breathing pores or stomata, thereby permitting the entry of gaseous phytotoxicants into the leaf. Light, temperature, humidity, soil moisture, fertility conditions, and stage of growth all play a part in controlling gas absorption by the plant. Plant injury due to sulfur dioxide, fluorides, oxidants, chlorine, hydrogen sulfide, ammonia, mercury vapor, and ethylene are considered. The use of plants in measuring and evaluating air contaminants is discussed, as well as the inspection of plants in making a field survey.

42924

EFFECT OF AIR POLLUTION ON FARM ANIMALS. In: Air Pollution Manual. Part I. Evaluation. Detroit, American Industrial Hygiene Assoc., 1960, Chapt. 6, p. 63-71. 97 refs.

The susceptibility of animal species to air pollutants will vary according to the specific contaminant in question. In addition to different species susceptibilities, individual animal variations also exist within each species. The lesions produced by air pollutants depend on the toxic property of the pollutants, the dosage rate, the duration of the exposure, and the susceptibility of the animal. Criteria are listed for the diagnosis of injury by air pollutants. It is important in investigating the effects of air pollutants on farm animals to ascertain whether any abnormal condition found is the result of the pollutants in question or some other stress. Nutritional disorders, metabolic diseases, mineral deficiencies, and accidental poisoning are considered. Adequate information is needed on the dosage range of the contaminants to which the animals are subjected, and a careful meteorological study of the area should be included. Tissue samples may provide an important source of data when animal injury has resulted from specific known pollutants. The effects of arsenic, fluorides, lead, molybdenum, and sulfur dioxide on farm animals are discussed, including threshold limit values and toxic tolerances.

42946

Gyoerkoes, T. and J. M. Baretincic

DETERMINATION OF F IN VEGETATION WITH F SELECTIVE ION ELECTRODE. Preprint, American Inst. of Mining, Metallurgical and Petroleum Engineers (AIME), New York, N. Y., p. 489-495, 1971. 1 ref. (Presented at the American Institute of Mining, Metallurgical and Petroleum Engineers, Annual Meeting, 100th, New York, Feb. 26- March 4, 1971.)

Preliminary work of the Boyce Thompson Institute was evaluated and some modifications were made. In the modified method, the fluorine is leached out of the ground vegetation using perchloric acid. The sample is then filtered and the filtrate is made up to 100 ml with a buffer containing sodium carbonate, sodium chloride, and sodium citrate. The sample solution should now have a pH of approximately 5.5 and is ready to be read after calibration of the meter with suitable standards. The results of electrode analysis (potentiometry) of 140 vegetation samples with values ranging from 3 to 500 ppm compared to automated analysis shows a correlation of 0.993 and the regression equation indicated a slope of 1 and an intercept of 1.7 ppm. The procedure as modified uses more HClO4 than does the Boyce Thompson method. Also, the application of a wetting agent to both the acid and buffer solutions gives better solution contact with the finely ground sample, yielding a more efficient extraction of fluoride.

42954

Knabe, W.

AIR POLLUTION - FOREST SITE FACTOR OR EVIL WHICH CAN BE KEPT OFF? - RECOMMENDATIONS FOR THE DETECTION AND CONTROL OF FUME DAMAGE IN A FOREST-RANGE. Forstarchiv, 42(8/9):172-179, 1971. Translated from German. 29p.

Ways in which the forest ranger can assess the effects of fumes on the forest trees are suggested. In judging these effects three cases must be distinguished: single sources, congested areas, and long-range effects. The plant damage that may result from each of these cases is described in detail. Three field methods to clarify suspicion of fume damage in a forest range are described. The first of these involves testing the needles of pine branches for the degree of needle foliage, degree of pollution, needle color, and distribution of damage to the needles. Evaluation of the lichen vegetation on tree bark can also provide information about fume damage. Lichens are killed off by very small concentrations of sulfur dioxide, hydrogen fluoride, and hydrochloric acid. The third field method involves determining the pH value of precipitation. The following values are given to aid in evaluating the pH readings: 2.0-3.0 - suspicion of strong effects from acid fumes; 3.1-4.0 - suspicion of slight effects from acid fumes; 4.1-6.0 - no indication for acid or alkaline fumes; 6.1-7.0 - suspicion of slight effects from alkaline fumes; and 7.0 - suspicion of strong effects from alkaline fumes. It is noted, however, that the most reliable proof of fume damage is a matter of scientific investigation by trained experts.

42958

Daines, Robert H., Ida Leone, and Eileen Brennan

THE EFFECT OF FLUORINE ON PLANTS AS DETERMINED BY SOIL NUTRITION AND FUMIGATION STUDIES. Interdepartmental Committee on Air Pollution, Washington, D. C., Air Pollut., Proc. U. S. Tech. Conf., Washington, D. C., 1950, p. 97-105. 4 refs. (May 3-5, Louis C. McCabe, ed.)

Results of experimental studies of fluorine toxicity and mechanisms of action in various plant species are reported, indicating that plants absorb F from both the atmosphere and soil, thereby accumulating the abnormally high F content that causes development of typical toxic symptoms. A means of distinguishing between F from the air or from the substrate was determined, since atmospheric F results in a high leaf and low root F content, whereas soil F causes a high leaf and even higher root content. Plant species vary in their threshold concentrations that cause visible injury, in capacity for uptake of F, and in the relation between F content and the extent of injury. Plants grown with optimum supplies of nitrogen, calcium, and phosphorus are more susceptible to F injury from the soil and, to a less extent, from the atmosphere than plants with unbalanced nutrition. As the soil pH increases, F toxicity and the amount of F absorbed are minimized High atmospheric humidity, turbidity of the plant, and wetting of the plant surfaces are conducive to a greater degree of injury and F absorption. A loss of F in plant leaves following an exposure to F in solution or in the atmosphere is being studied. (Author conclusions modified)

43226

Aschbacher, P. W.

AIR POLLUTION RESEARCH NEEDS WITH ANIMALS. Preprint, Air Pollution Control Assoc., Pittsburgh, Pa., 31p., 1972. 107 refs. (Presented at the Air Pollution Control Association, Annual Meeting, 65th, Miami Beach, Fla., June 18-22, 1972, Paper 72-153.)

Based on published reports, air pollution problems relating to livestock are identified. These are discussed under two categories: pollutants from industrial-urban sources affecting livestock, and pollutants originating from animal production units. The available knowledge concerning these problems is briefly described. Air pollution from industrial sources affecting farm livestock is usually the result of accumulation of the pollutant on forage in a localized area surrounding the source and the animals affected are primarily herbivores. Specific pollutants discussed in this regard are fluorine, lead, molybdenum, cadmium, and arsenic. In the second category, available information on specific pollutants identified as arising from various livestock production systems is presented. In any animal production system, volatile compounds from decomposing manure may be released into the atmosphere. In some cases, these gases may have adverse effects on the animals in the housing unit, or they may possess such odors as to be considered a public nuisance. Gases present in poultry, swine, and cattle housing units are identified. Of all problems identified, extensive information is available only for fluorosis, and in all cases the knowledge to assess the situation completely is lacking. (Author abstract modified)

43492

Garber, K.

STUDIES AND EVALUATION OF SMOKE DAMAGES. (Untersuchung und Begutachtung von Rauchschaeden). Jahresber. Staatinst. Angew. Bot., Hamburg, vol. 76/78:119-127, 1961. 13 refs. Translated from German. 12p.

A summary is presented of 666 studies and evaluations conducted in the field of smoke damage to vegetables, ornamental plants, fruit and other trees, and bushes. A large number of plants are categorized based on their individual sensitivity to hydrofluoric acid and sulfur dioxide gases. Depending on their chemical composition, dusts can have damaging effects on both plants and soil fertility. The calcium oxide content in soil in the vicinity of a cement plant was studied. Plant damage is traced to chlorine- containing fumes in conjunction with amonia from a zinc extrusion plant and to sulfur-containing exhaust gases from warm slag used to repair sidewalks. High amounts of molybdenum in plants can be toxic to ruminants.

43493

Garber, K.

STATE AND ATTAINMENT OF AGRICULTURAL CHEMICAL AND AGRICULTURAL BIOLOGICAL RESEARCH. (Stand und Leistung agrikulturchemischer und agrabiologischer

Forschung). Landwirtsch Forsch., no. 20:116-118, 1966. 6 refs. Translated from German. 5p.

The increased fluorine content in plants in regions of fluorine emission was investigated to ascertain whether this increase might also be due to absorption from the soil. The fluorine content in different plant types in different soils, the effect of single or split application of fluorine on the growth and F content of plants and the extent of increased F content in the soil on plants was researched. The findings proved that the F content in plants does not run parallel to the natural F content of the soil. Fine, sandy, marshy and clay soils were tested. Bush beans were the experimental plants. (Author abstract modified)

43622

Drinker, Phillip

AIR POLLUTION AND THE PUBLIC HEALTH. POLLUTION BY FLUORIDES. Roy. Inst. Public Health Hyg. J. (London), vol. 20:307-316, Sept. 1957. 21 refs. (Presented at the Royal Institute of Public Health and Hygiene)

The effects of sulfur dioxide, fluorides, ozone, and Los Angeles smog on plants are reviewed. The emissions of dusts, grit, and ash and their control by isolation are considered. The regulation of industrial and vehicular exhaust air pollution are presented. Fluoride contaminants mentioned are: hydrofluoric acid, silicon tetrafluoride, sodium fluoride, and calcium fluoride.

43663

Jamrich, V.

IS CHLOROPHYLL STABILITY A FACTOR IN THE POWER OF RESISTANCE AGAINST FUMES? (Je stabilita chlorofylu faktorom odolnosti proti dymu?). Zbornik Vedeckych Prac Lesnickej Fakulty Vysokej Skoly Lexhickej a Drevarskij Vo Zvolene, vol 1:7-14, Oct. 1968. 14 refs. Translated from Czech. 14p.

The relationship between the intensity of the effects of gaseous fluorine compounds, in the form of industrial emissions, and the degree of chlorophyll destruction in two species of trees was studied. Alnus glutinosa was selected to represent the resistant species, and Quercus patraea to represent the species of low resistance. Each species was exposed to a definite amount of fluorine, and the degree of depigmentation was expressed in terms of the differences in the total chlorophyll and the differences found in the components, chlorophyll a and chlorophyll b. The degree of chlorophyll destruction is directly proportional to the intensity of exposure to fluorine; the degree of depigmentation is also dependent on the strength of the chlorophyll bonds in the plastid structures. Depigmentation is continuous with changes in the ratio of chlorophyll components, and chlorophyll b is relatively more stable than chlorophyll a. (Author summary modified)

44295

Oelschlager, W.

DETERMINATION OF FLUORIDE STANDARDS FOR VEGETATION AND ANIMALS. Fluoride, 5(3):11?-11?, July 1972. 1 ref.

In determining fluoride emission standards with respect to possible damage to vegetation, better results are obtained if gaseous fluoride is considered exclusively. However, in evaluating damage to animals, fluoride uptake in gaseous or through respiration is negligible compared with uptake through forage, soil, and fly ash. Soil and fluoride, emitted with fly ash near factories, is attached to raw forage such as grass, clover, and alfalfa. Since the amount of fluoride in soil is approximately 20 to 150 times as high as the fluoride content of forage and that of fly ash is more than 1000 times as high, the question arises as to whether or not the solid particles should be considered when measuring emissions. When nearly identical supplements of fluoride, namely 72 ppm, in the form of soil, sodium fluoride, and fly ash from an aluminum factory smelter, were administered to cattle, the fluoride uptake from soil was 0.7 times, from fly ash 1.4 times, and from sodium fluoride 3.0 times as high in the experimental animals as in those which received the fluoride supplement. The utilization of fluoride derived from soil in ruminant animals is highly variable depending on the origin of the soil. The fluoride from soil and fly ash is more or less available, although at lower magnitudes, than fluoride contained in forage. However, if for establishing emission standards, particulate fluoride in addition to gaseous fluoride is being considered, values can be obtained which are not in accord with the possible damage to animals. Thus, damage to health may be more extensive with a relatively low gaseous emission than with a high level depending on the proportion of fluoride in the gaseous and particulate form. As a maximum value for fluoride content of forage, 40 ppm/day is being considered for high productive cattle. This value, however, is not only reached, but occasionally substantially exceeded, in non-polluted areas, because of the top permissible fluoride levels in phosphate-containing feed.

44345

Leonard, C. D. and H. B. Graves, Jr.

EFFECT OF FLUORIDE AIR POLLUTION ON FLORIDA CITRUS. Fluoride, 5(3):145-163, July 1972. 15 refs.

The effect of different concentrations of fluorides in the leaves on the yield and quality of Valencia and Hamlin oranges and Marsh seedless grapefruit was studied. Under Florida conditions, exposure of citrus trees to relatively high levels of airborne fluorides during spring bloom period is believed to cause the greatest losses in fruit production. This in indicated by the significant reduction in yield of Hamlin oranges by each of three different concentrations of hydrogen fluoride sprays applied only three different times during the 1967 bloom period. Where the concentration of airborne fluorides is high enough during the bloom period to cause extensive leaf chlorosis, leaf burn, dropping of young leaves, and excessive dropping of bloom and small fruit, the mechanism causing yield reduction is obvious. Heavy drop of young leaves, bloom, and small fruit as a result of exposure to high levels of airborne fluorides, however, has occurred in relatively few Florida citrus groves. These symptoms of acute or severe fluoride toxicity did not occur on the trees in greenhouse experiments. In spray experiments, leaf burn and dropping of young leaves occurred only moderately when the highest concentration of HF sprays was applied while the trees has an extensive new flush of immature leaves. No dropping of young leaves nor excess dropping of bloom and small fruit occurred during the bloom period in the first three years of the spray experiments. Decrease in photosynthetic activity due to smaller leaf size and inhibition of chlorophyll synthesis probably accounts for much of the decrease in yield. The addition of urea to high managanese sprays for regreening of fluoride-chlorotic leaves appears to increase the absorption of Mn by the leaves over similar high Mn sprays with urea.

44411

Bossavy, J.

ATMOSPHERIC POLLUTANTS: THEIR EFFECTS ON VEGETATION. (Les polluants atmospheriques. Leurs effets sur

la vegetation). Text in French. Rev. For. Fra., 22(5):533-543, 1970.

After a 10-year period of observations in France on the effects of industrial wastes on vegetation, an in-depth examination was conducted on symptoms of fluorine and sulfur dioxide pollution, on certain measurement methods, on types of studies conducted over a 3-year period in the Alps, and on the principal features of the territory where damage information was gathered. Measurements were made using lime-impregnated paper to determine concentration of fluorine deposits on vegetation. It was established that fluorine not metabolized by vegetation penetrates the cells of the parenchyma of leaves and is transferred and retained in the extremities of edges of the limb. Depending upon the vegetation, fluorine damage (burns) is evident on leaves in the form of various tints such as light brown, black, or brick red. Caution is recommended in order that late frost damage not be confused with pollution damage. Ozone damage is characterized by small brown spots on the upper surfaces of leaves; photochemical smog produces silver-white spots on the bottom of leaves. Peroxide acetyl nitrate produces a vitreous or metallic silver-white tint on the bottom of leaves. Little is known about the effects of nitrogen oxides. Research findings are described and discussed according to specific effects of pollutants on specific types of vegetation by regional measurements. (Author abstract modified)

44428

Gisiger, L.

ON THE FLUORINE CONTENT OF SOILS AND ITS ABSORPTION BY PLANTS AND ANIMALS. (Ueber den Gehalt der Boden an Fluor und dessen Aufnehmbarkeit durch Pflanze und Tier). Text in German. Schwiez. Landwirt. Monatsh., 44(6):221-230, June 1966. 3 refs.

Soil samples in Fricktal in the Canton of Aargan, Switzerland, were studied to determine if a fluorine increase on the soil surface was traceable to the emissions of an aluminum plant. Guided by the literature and a similar study made in 1962 to investigate the influence of the clay content of soil on its F content, the soil was examined in accordance with the dominant wind direction from the aluminum plant. Soil was studied at depths of 0. to 2.5 cm and 2.5 to 10 cm. Examination of F content in representative vegetation evidenced no recognizable dependence from 26 to over 100 mg% of the soil samples studied. Among the many results of the research discussed and presented in tabular format are the findings involving feeding hay to sheep and determining F retention and absorption by analyzing their urine and excrement. Fluorine toxicity of the soil yielded a sodium fluoride equivalence of approximately two-thirds. The specific phases of the research discussed are: solubility of F in soil, absorption of F by plants in soils of differing F content, and F resorption through pollution as measured in ruminants. (Author abstract modified)

44595

Largent, Edward J.

FLUORIDE DAMAGE TO PLANTS. In: Fluorosis. The Health Aspects of Fluorine Compounds. Columbus, Ohio State Univ. Press, 1961, Chapt. 10, p. 94-100.

The reactions of various plant species have not been found to be consistent with respect to the effects of fluorides, sulfur dioxide, and some other materials that injure plant tissues. Distinguishing between damage caused by SO2 and that caused by fluorides can be difficult and complicated. The effects of hydrofluoric acid on certain broad, flat leaves include injury to and death of marginal areas or of the tips of the leaves, and some spotting and killing of scattered areas of interveinous tissue. Another type of flat leaf exposed to HF in air showed injury at the tips, streaking, spotting, and mottling. Tips of the needles of pine trees first turn yellow and then brown as a result of exposure to HF. Certain plant species appear to be sensitive to very low concentrations (below 5 ppb) of HF in air while others appear to be quite insensitive to HF, with only slight injuries being noted at concentrations of greater than 10 ppb. In general, the accumulation of fluoride is smallest in the fruit and greatest in the leaves; stems and twigs occupy an intermediate position. When fluoride enters a plant through its roots, it injures the leaves in much the same manner as does air- borne HF. Deposition of particulate fluorides on leaf surfaces is usually not injurious to the leaves or other parts of the plant.

45007

Garber, K.

EFFECTS OF AIR POLLUTANTS ON PLANTS. (Auswirkungen von Luftverunreinigungen auf Pflanzen). Text in German. Mitt Deut. Landwirtsch. Ges. (Frankfurt), 84(20):673-674, 1969.

Effects of different air pollutants on plants are described. The influence on plants of air pollutants can be determined through analyses of the air, precipitation, plant parts, and soil samples. Trees are hit harder by emissions than argicultural plants, and the resistance against pollutants can be increased by lime and nitrogen doses. Gaseous pollutants usually penetrate plants through the stomata of leaves. Sulfur dioxide, mainly causing intercostal necrosis of leaves, is more dangerous during the daytime and in humid weather than at night and in dry weather. A small proportion of SO2 incorporated is converted into sulfates, and elevated sulfur levels in leaves due to the effect of emissions can be detected. Lettuce, spinach, and bean were found to be particularly sensitive to SO2. The acidification of soils is another consequence of SO2 emissions. Fluorine, in the form of hydrofluoric acid, deposits in the points and edges of leaves, and also soluble fluorine salts can be absorbed by leaves. The background concentrations range from 0.5 to 1.8 mg/100 g of dry substance. Hydrochloric acid, having a shorter action radius than SO2, causes necrotic edges on leaves, and can be detected in the form of chlorides. Nitrogen oxides cause largely the same symptoms as SO2. Plant damages due to ammonia near fertilizer, urea manufacturing plants, and largely poultry farms were observed. Tar vapors cause dark brown to silver coloration of leaves. Dusts, though less dangerous than gaseous pollutants, may cause damages by coating leaves and penetrating into the soil. Reduced production due to zinc and lead containing dusts was determined in experiments.

45009

Bennett, Jesse H. and A. Clyde Hill

ABSORPTION OF GASEOUS AIR POLLUTANTS BY PLANTS: INVESTIGATIONS INTO POLLUTANT CONCENTRATION PROFILES IN A STANDARDIZED CANOPY. Preprint, Air Pollution Control Assoc., Pittsburgh, Pa., 22p., 1972. 17 refs. (Presented at the Air Pollution Control Association, Annual Meeting, 65th, Miami, Fla., June 18-22, 1972, Paper 72-156.)

Concentration profiles for hydrofluoric acid, sulfur dioxide, ozone, nitrogen dioxide, and nitric oxide generated in a standardized alfalfa canopy are presented. Wind, light, temperature, and carbon dioxide profiles, pollutant uptake, and canopy data are given. Canopy pollutant concentration profile characteristics of major air pollutants were studied to evaluate

their potential for penetrating into canopies. The study was conducted in an environmental growth chamber which allowed automatic control of environmental conditions and gaseous exchange. The steady state HF profile showed the greatest displacement within the canopy. Hydrofluoric acid, SO2, and NO2 profiles suggested that these gases may be removed efficiently by the upper portion of the canopy as well as the immediate subsurface vegetation. The steady state NO profile was not substantially displaced within the canopy. The meager uptake rate of NO by plants was too slow in comparison with gas transport and mixing within the canopy to materially affect the internal profile. Ozone appeared to be readily deposited on the surface tissues, but the lower tissues had less effect on the concentration profile. Data are presented which show the relationship between the NO2 concentration within the canopy and changes in the air concentration above the vegetation. The NO2 concentration was oscillated (between 9-11 pphm) above the canopy. The amplitude of oscillation was damped within the canopy in proportion to the depression in mean concentration at that level. (Author abstract modified)

45022

Berge, Helmut

THE PROBLEM OF AIR POLLUTION. (Das Problem der Luftverunreinigung). Text in German. Angew. Bot., no. 37:299-311, 1964. 10 refs. (Presented at Muenster University, West Germany, Botanical Institute, Jan. 8, 1963.)

The general problem of air pollution-induced plant damage and morphological and physiological alterations in damaged plants are rewiewed. The effects of air pollutants on plants are dependent on and modified by climatic, orographic, edaphic, and biotic factors; the synergism of pollutants; and differences in the sensitivity of individual plants and species. Sulfur dioxide and fluorine are the most dangerous pollutants for plants, but ammonia, hydrogen sulfide, nitrogen oxides, nitric acid, chlorine, hydrochloric acid, bromine, iodine, hydrocyanic acid, ethylene, carbon monoxide, hydrocarbons, mercaptans, asphalt and tar vapors, mercury, and selenium can also inflict damage. Young leaves, sensitive to H2S, nitrogen oxides, Cl, HCl, HCN, mercaptans, Hg, and sulfuric acid, are more resistant to SO2, gaseous F compounds, ethylene, and selenium than older leaves. Damage is most serious when pollutants enter leaves simultaneously or alternately through epidermis and stomata. Solution of the cellular matter due to SO2, H2S, nitrogen oxides, HNO3, Cl, HCl, mercaptans, and selenium was observed. The yellow-to-brown coloration of leaves is usually a result of the precipitation of tannin. Plasmolysis is caused by SO2, gaseous F compounds, ammonia, nitrogen oxides, HNO3, Br, asphalt and tar vapors, while photosynthesis is stimulated by traces of ammonia, HNO3, and saturated hydrocarbons. Increased dissimilation and respiration due to diverse pollutants, increased transpiration due to SO2 and HCl, and elevated permeability and osmosis due to SO2 were observed. The stomata are choked by dust, soot, and fly ash buildups.

45130

Forest Service, Atlanta, Ga. Environmental Protection and Improvement

AIR POLLUTION AND TREES. 13p., 1971. 14 refs.

The most common pollutants injuring trees are sulfur dioxide, fluorides, oxidants, and minor air pollutants such as ammonia, chlorides, and ethylene. The sources of sulfur dioxide are coal burning (60%); refining and combustion of petroleum products (21%); smelting of ores (7%); and minor amounts generated by natural gas production, refining and utilization of sulfur, and manufacturing and utilization of sulfuric acid. Fluoride injury to plants in the United States became widespread after World War II, when the aluminum and other industries grew rapidly. Ozone, a naturally occuring oxidant existing in the upper atmosphere, may be brought to earth by turbulence during severe storms, and small amounts are formed by lightning. Most other oxidants come from the emissions of automobiles and industries which mix in the air and undergo photochemical reactions in sunlight. Oxides of nitrogen are formed by combustion at high temperatures in the presence of two natural components of air, nitrogen and oxygen. Automotive exhaust is the largest producer of nitrogen oxides. Ethylene comes from the manufacture of illuminating gas, automobile exhausts, combustion of various fuels or any organic substance, petroleum refining, and manufacturing of polyethylene. Hydrogen chloride and chloride originate from refineries, glass-making plants, incineration, accidental spillage, and burning of polyvinyl chloride plastics. Ammonia injury to plants and plant products is caused by refrigeration gas escaping in cold storage rooms, from fertilizer tanks, or during various manufacturing processes utilizing or making ammonia. The injury caused to plants, including symptoms is described. Symptoms may be chronic or acute. A general yellowing of needles occur. Growth is impeded. Leaf margins begin to die. Tips of conifer needles turn brown and die. In the case of broadleaved trees, leaves turn yellow, or get small flecks of dead or pigmented tissue on the upper leaf-surface. Air pollution may injure trees many miles away from pollution source, especially during inversions, when pollutants are trapped and concentrated close to the ground. Air pollution is also responsible for retarding growth and weakening trees to attack by various insects and diseases. Air pollution problem to forestry is a near-future problem, and will depend upon population growth, engineering technology, willingness of private individuals and industry to become involved, and issuing adequate laws controlling the situation. (Author conclusions modified)

45160

Bohne, H.

INJURIES FROM DUSTS OF CEMENT WORKS ON THE FOREST STANDS. (Schaedlichkeit von Staub aus Zementwerken fuer Waldbestaende). Text in German. Allg. Forstz., 18(7):109-111, 1963. 4 refs.

Investigations of forest damages due to dust emissions from cement works are described. Tree leaves were covered by whitish-gray dust deposits, often in the form of a hard film, and many dead trees, mostly conifers, were found. Dust sedimentation measurements over one year revealed sedimentation rates of 1.7 g/sq m/day as a monthly average, while weekly averages reached 3.8 g/sq m/day. The dust contained 30-40% lime, 15-20% silicic acid, 5-45% sulfur, about 1% potash, up to 0.15% fluorine, and traces of iron and aluminum. The pH values ranged from 8 to 12. The dust, of high binding ability, resembled cement in its behavior in the presence of humidity. The dust deposits reduced the assimilation, and, due to being highly alkaline and containing hydroxyl ions and water-soluble salts, damaged or destroyed the cell matter. Also lenticels in the bark were affected. Measurements of annual ring widths revealed considerable reduction in growth, parallel to the increase in the cement production. The annual rings in a poplar were 8.5 mm wide during the period 1925-1930, as against 3.8 mm in the period 1951-1960. The width of the annual rings in conifers decreased from 2.1-2.5 mm in the period 1911-1920 to 1.4 mm during 1951-1960.

45214

Houten, J. G. ten

AIR POLLUTION AND PLANT HEALTH. OEPP/EPPO Bull., no. 4:65-77, 1972. 20 refs.

Plant injury due to chemical air pollutants (sulfur dioxide, hydrofluoric acid, ethylene, ozone, and peroxyacetyl nitrate is a well-known phenomenon in densely industralized and urbanized areas. Several studies on the physical, chemical, and biotic influences of pollutants are reviewed. Little is known about the influence of air pollutants on the development of parasitic plant diseases and insect pests, and only in a few cases has the effect of the presence of certain pathogens in plant leaves on symptom-expression resulting from chemical air pollutants been investigated. In some instances, virus-diseased plants are less susceptible to air pollutants. In exceptional cases, air pollutants may reduce plant diseases. Some pollutants may inhibit spore germination of certain pathogens, whereas other pathogens are not influenced at all or may even be stimulated.

45345

William, A.

AIR, PRIMORDIAL FACTOR OF THE ENVIRONMENT. (L air, facteur primordial de l environnement). Text in French. Ann. Gembloux, 77(2):111-120, 1971. 9 refs.

A historical review is given of air pollution, and studies on plant damage due to air pollutants such as sulfur dioxide, hydrogen fluoride, hydrochloric acid, nitric acid, nitrous acid, ammonia, hydrogen sulfide, bromine, and mineral oils are summarized. The relative sensitivities of certain plants for air pollution are given. Atomic oxygen may react with nitrogen oxides and saturated hydrocarbons, forming peroxyacetyl nitrates and peroxypropyonyl nitrate. Sulfur dioxide present in air may be oxidized by ozone to sulfur trioxide to form finally sulfuric acid. Plant leaves develop whitish or brown spots within a few minutes on the action of ozone in concentrations of 0.1-0.2 ppm. Epiphyte plants and lichens are regarded by many scientists as the best pollution indicators. Territorial development plans for different regions of Belgium are reviewed with regard to air pollution prevention.

45467

Schucht, F., H. H. Baetge, and M. Dueker

SOIL INVESTIGATIONS IN THE OKER METALLURGICAL PLANT AREA (HARZ MOUNTAINS, GERMANY). (Ueber bodenkundliche Aufnahmen im Rauchschadengebiet der Unterharzer Huettenwerke Oker). Text in German. Landwirt. Jahrb., vol. 76:51-98, 1932. 39 refs.

Soil investigations were carried out in a smoke-damaged forest area around the Oker metallurgical plant in the Harz mountains. The damages were primarily due to sulfur dioxide which formed sulfur trioxide and then sulfurous acid. Other pollutants, such as carbon dioxide, nitrogen oxides, and dusts containing copper, zinc, arsenic, lead, and traces of cadmium as well as traces of hydrofluoric acid and chlorine, were also detected. Soil samples showed increased soil sulfate contents around the metallurgical works, and an irregular decrease of sulfate levels with distance. The lime contents decreased due to the effect of sulfurous acid, as did magnesia and potassium concentrations. The soil pH ranged from 6.7 to 7.5. Copper contents of 0.04-0.007%, decreasing irregularly with distance, were measured, while both the zinc and lead contents, 0.16% and 0.14-0.0007%, respectively, were highest in the immediate proximity of the plant due to rapid sedimentation. Dusts containing arsenic had the largest action radius, and it was possible to determine the extension of the smoke damage area from the soil arsenic levels. Since copper, zinc, lead, and arsenic were present in the form of water-insoluble salts in soils with adequate lime contents, damages due to these metals were not probable, and soil acidification due to SO2 could be counteracted by proper fertilization.

45474

Bohne, H.

INVESTIGATION OF AIR POLLUTION-INDUCED PLANT DAMAGES. (Untersuchung von Pflanzenschaeden durch Luftverunreinigung). Text in German. Mitt. Deut. Landwirtsch. Ges. (Frankfurt), 80(20):684-685, 1969.

The investigation of air pollution-induced plant damages is described, with special regard to the production of evidence for legal proceedings. Dead trees near industrial plants, asymmetric growth, and yearly recurring coloration, appearing during spring or early summer, are the general symptoms of the influence on vegetation of industrial activity. The chemical analysis of plant samples delivers usually unambiguous evidence. The problem is complicated by the presence of several industrial plants emitting different pollutants in the affected neighborhood. While fluorine contents in leaves decrease with increasing distance of the suspected emission source, chlorine and hydrofluoric acid are carried away from leaves by plant fluids. Repeated pollutant concentration measurements, preferably at different distances of the emission source, are necessary. The plant damage area should be divided into a number of zones according to the degree of the damage.

45533

Ryder, Edward J.

SELECTION AND BREEDING OF PLANTS FOR INCREASED RESISTANCE TO AIR POLLUTANTS. Preprint, American Chemical Society, Washington, D. C., 1971. 35 refs. (Presented at the American Chemical Society, National Meeting, 161st, Los Angeles, Calif., March 28 - April 2, 1971.)

A few crops, ornamental plants, and forest plants were investigated for variations in reaction to air pollution. Evidence for a genetic basis for resistance to pollutants was found in several specie. Plant breeding techniques and current breeding programs are listed. The effects of the following toxicants are reviewed: ozone, fluoride, oxidants, sulfur dioxide, nitrogen dioxide, and peroxyacetyl nitrate. Future needs and prospects are discussed. Breeding new varieties of plants, resistant to the toxicants, which can be sucessfully grown in a polluted atmosphere is considered.

45540

Heggestad, H. E., F. S. Santamour, Jr., and Leon Bernstein

PLANTS THAT WILL WITHSTAND POLLUTION AND REDUCE IT. In: Landscape for Living. Washington, D. C., Government Printing Office, 1972, p. 16-22. GPO

Ozone, peroxyacetyl nitrate, sulfur dioxide, nitrogen dioxide, fluorides, and ethylene are pollutants that singularly or in combination can cause damage to plants in the form of lesions, tissue collapse, discoloration, defoliation, premature aging, and necrosis of leaf margins and tips. The concentration of these pollutants is high enough in some areas to result in economic losses. The sensitivity of the plants can be used to detect the presence of these pollutants and to augment monitoring instruments. Trees and other plants also play a role in removing gaseous pollutants and particulates from the atmosphere and in reducing noise. The ginko and the Ailanthus are two species

which have been grown successfully in urban areas. Natural selection will result in more resistant plants, but the cultivation of particular species is desirable.

45557

Wood, Francis A.

AIR POLLUTION RESEARCH NEEDS IN FORESTRY. Preprint, Air Pollution Control Assoc., Pittsburgh, Pa., 20p., 1972. 10 refs. (Presented at the Air Pollution Control Association, Annual Meeting, 65th, Miami, Fla., June 18-22, 1972, Paper 72-152.)

Research needs with respect to the effects of air pollution on forests are presented. The principal difference between research needs pertaining to forests in comparison with those pertaining to herbaceous plants is a function of the perennial nature of forests. Research areas that need attention in the future include: a determination of the impact of air pollution on forests, the effects of pollutant interactions, the effect of pollutant-biopathogen interactions, an examination of changes in the nature of air pollution problems associated with applications of control technology, the development of additional field diagnostic techniques, and the use of chemicals and resistant plant materials to minimize air pollution effects. The effects of specific air pollutants, such as sulfur dioxide, hydrogen fluoride, ozone, peroxyacetyl nitrate, and hydrogen chloride, at the cellular, whole plant, and plant community levels need to be elucidated. (Author abstract modified)

45604

Carlson, Clinton E. and Jerald E. Dewey

ENVIRONMENTAL POLUTION BY FLUORIDES IN FLATHEAD NATIONAL FOREST AND GLACIER NATIONAL PARK. Forest Service, Missoula, Mont., Forest Insect and Disease Branch, 62p., Oct. 1971. 27 refs.

The major cause of vegetation injury and damage on forested lands near the Anaconda Aluminum Company was studied. Research took the form of studies of visual burn, chemical analysis, histological analyses, aerial photography of area, and entomological (insect) sampling. Fluorides generated by the Anaconda Aluminum Company were determined to be the primary cause of the injury and damage to vegetation in the surrounding area. Highest fluoride concentrations, up to 1000 ppm, in foliar tissue were found near the Anaconda aluminum plant. Data indicated the fluorides were carried by air movement from the aluminum plant through a saddle in Teakettle Mountain to Glacier National Park, following the pattern of the prevailing winds in the area. Elevated fluorides (greater than 10 ppm) were found in vegetation on Columbia Mountain and Teakettle Mountain, in vegetation near the towns of Columbia Falls, Hungry Horse, and Coram, Montana, and in the southwest portion of Glacier National Park. Varying degrees of visible fluoride injury were found on vegetation over more than 69,120 acres. Although fluoride emissions were reduced during the summer of 1970, fir and spruce trees continued to accumulate fluorides at the same rate as in 1969. Definite histological reactions to elevated fluorides occur in conifer needle tissue, including hypertrophy of parenchymatous cells. Fluorides also accumulated in insect tissue. All groups of insects studied contained high fluoride levels. Pollinators possessed the highest, up to 406 ppm. Cambium feeders contained in excess of 52 ppm, indicating that fluoride must be translocated in the cambium of trees. Predatory insects had fluoride counts over 53 ppm, showing fluoride is passed along the food chain. Insect population samples indicated that elevated fluoride levels in pine needles lead to a buildup of the pine needle scale. During the summer of 1971, evaluations of possible timber growth losses and pasture grazing lands the should not be utilized due to fluoride were evaluated. Environmental damage can be stopped only by installation of pollution abatement equipment to limit fluoride emission to 0 lb/day, which is impossible, or by closing the plant, which is also impossible. The only possibility left is installing a permanent system to monitor fluoride pollution. (Author conclusions modified)

45663

Compton, O. C., F. W. Adams, Stanley Elliott, Jack H. Wood, D. W. Claypool, and R. K. Marsh

FLUORINE LEVELS IN PLANTS OF THE WARRENTON AREA, 1968-1970: CULTIVATED AND NATIVE WOODY AND HERBACEOUS PLANTS PRIOR TO ALUMINUM FACTORY OPERATIONS. Oregon Agricultural Experiment Station, Corvallis, Rept. 335, 30p., July 1971. 32 refs.

The flourine level of plants in an area intended for construction of an aluminum plant was studied to supply reference data in anticipation of pollution after start of plant operation. Cultivated and native plants within 6 mi of the factory site were sampled. Pasture herbages contained an average of 0.8-3.2 ppm fluorine, with only 11% of the samples exceeding 3.4 ppm. The fluorine content of each of the other six species averaged 2.9 ppm, with the exception of spruce needles containing 4.2 ppm. Five improved strains of pasture grasses maintained in pure strands were consistently and uniformly low in fluorine content. Within the area, differences in terrain, river valley, or distance from projected factory site produced no trends in fluorine concentrations. (Author summary modified)

45776

Heggestad, H. E.

HOW PLANTS FIGHT MAN-MADE POLLUTION. Sci. Teach., 39(4), 4p., April 1972. 22 refs.

Various investigations concerning the response of plants to polluted environments are reviewed. Removal of ozone by plants is regulated by the same factors that control the exchange of water vapor between the leaves and the atmosphere. Depending on the species, ozone concentration, and other factors, uptake of ozone by leaves often results in acute injury, premature aging, and plant senescence. Sulfur absorption by plants is least when the concentrations of sulfur dioxide are highest. Sulfur accumulation may occur even under pollution conditions which do not depress plant yield or the quality of plant products. The initial uptake rate of nitrogen dioxide by alfalfa and oats is directly proportional to concentration in the range of 0 to 24 pphm. Alfalfa removes gaseous pollutants in the following order: hydrogen fluoride most rapidly, followed by sulfur dioxide, chlorine, nitrogen dioxide, ozone, peroxyacyl nitrate, and nitric oxide. The absorption rate of nitric oxide is very low, and it is not possible to detect any absorption of carbon monoxide. There is a close relationship between the uptake of these pollutants by plants and their solubility in water. The action of various woody plants on SO2 removal is described. Soil organisms, including fungi, yeast, and bacteria, also play an important role in air purification, especially for gases such as CO and ethylene, which are not absorbed by green plants. soil also acts as an effective sink for SO2 and NO2. Trees, shrubs, and tall grass make effective sound barriers and thus reduce noise pollution. Removal of particulates by plants has little, if any, effect on the vegetation itself, but plant removal of gaseous pollutants, such as ozone, PAN, sulfur dioxide, and chlorine, may cause injury to plants.

45781

Zietzschmann, Otto

CONTRIBUTION TO FLUORINE NOXIOUSNESS IN CATTLE. (Zur Frage der Schaedlichkeit des Fluores beim Rinde). Text in German. Deut. Tieraerztl. Wochschr., no. 39:203-204, 1931.

Observations on the effects of fluorine on cattle are described. Grazing cattle kept in a pasture near a chemical plant emitting hydrofluoric acid lost weight and showed symptoms of osteomalacia but never those of fluorine cachexia. The symptoms rapidly receded during winter when the animals were fed only little hay from the chemical plant area. Fluorine in grass and hay was detected, and vegetation damages in the form of reddish-brown spots on leaves and leaves turning yellow in summer were observed. In another case loss of weight and symptoms of osteodrystrophy were observed in cattle grazing near a plant which discharged fluorine bound in air borne dust. Osteodystrophy failed, however, to appear in tests in which cattle were fed 2.3 g/day of sodium fluoride and sodium fluosilicate, which indicates the possibility of the indirect action of fluorine.

46051

MacLean, D. C., L. H. Weinstein, D. C. McCune, R. H., and A. E. Hitchcock

A STUDY TO ASSESS THE IMPACT OF TOXIC PROPELLANTS ON KSC ECOLOGY. (FINAL REPORT). Boyce Thompson Inst. for Plant Research, Inc., Yonkers, N. Y. and TRW Systems, Cape Canaveral, Fla., Florida Operations, NASA Contract NAS 10-3147, 92p., Dec. 1966. 3 refs. NTIS: N67-35193

The impact of toxic propellants on plant species near the Kennedy space center was studied. Nitrogen tetraoxide, which is currently used as an oxidizer, and hydrogen fluoride, which would be the toxic vapor from a fluoride-based oxidizer, were the propellants studied. The study was concerned only with high vapor concentration, short duration exposures which might result from launch operations. The vapors of both propellants caused plant damage in proportion to the vapor concentration and exposure time. Boundary conditions for damage by nitrogen dioxide varied from 25 ppm for 4 hr to 250 ppm for 15 min. Boundary levels for hydrogen fluoride ranged from 15 ppm for 2 hr to 8 ppm for 4 hr. The minimal effects of both vapors on plant tissue resemble the symptoms produced by environmental stresses, insects, and diseases. The maximum effects observed included complete defoliation, abscission of flowers and fruits, and necrosis of terminal shoots. Vapor concentrations and/or exposure time significantly above the maximum levels studied in this program could be expected to produce complete necrosis of plants. Hydrogen fluoride was approximately 20 times more effective on a concentration basis than NO2 in inducing plant damage. Plant damage induced by HF can be distinguished from that induced by NO2 on the basis of the species affected, type of tissue injured, pattern of symptom development and expression, and chemical analyses. Injuries to plants observed in this study ranged from marginal effects through complete defoliation. The visible expressions of injury are described for a number of citrus varities and ornamental species.

46198

Hepting, George H.

AIR POLLUTION AND TREES. In: Man s Impact on Terrestrial and Oceanic Ecosystems. William H. Matthews, Frederick E. Smith, and Edward D. Goldberg (eds.), Cambridge, Mass., MIT Press, 1971, Chapt. 7, p. 116-129. 31 refs.

Coniferous trees, bearing the same foliage year-round and often for several years, are notable victims of air pollution. There is much variation among tree species in sensitivity to toxic airborne gases and great variation from tree to tree within the same species. Thus, some sensitive white pine trees are being propagated to provide a clonal line useful in monitoring air pollution, while other neighboring resistant white pines have permitted the production of clonal lines of trees that can withstand field levels of certain toxic gases. The main air pollutant gases toxic to trees are sulfur dioxide, fluorides, ozone, peroxyacyl nitrate, and oxides of nitrogen. Today the main damage to forest and shade trees results from the stack gas from coal-burning power plants and from the photochemical toxicants in urban smog. When trees were killed over thousands of acres around a smelter, the climate of the area was definitely altered adversely. Trees help screen out polluting industries and serve as fixed monitors of dangerous pollution levels. Trees have also been considered as sometimes contributing to atmospheric haze through photochemical combinations involving their aromatic hydrocarbons such as terpenes. Wisely used, trees can help in many ways in the struggle against air pollution. (Author abstract modified)

46217

Swieboda, Maria

CERTAIN ASPECTS OF THE EFFECT OF AIR POLLUTION BY INDUSTRIAL FLUORINE COMPOUNDS UPON FORESTS. (Niektore zagadnienia wplywu na lasy przemyslowych zanieczyszczen powietrza zwiazkami fluoru). Text in Polish. Sylwan, 108(6):45-54, 1964. 27 refs.

A brief review is given which emphasizes that the content of fluorine compounds in air, soil, and plants differs in different areas depending on the distance from industry (especially metallurgical aluminum, and fertilizers industries). The signs of the adverse effects of fluorine pollution are described in detail. Resistance of plants differs in different species. Of the evergreens, the most sensitive are the pine (75-85%), spruce (26-75%), and fir (3-12%), and least sensitive is the larch (less than 1%). Of deciduous trees, the most sensitive is the beech tree, while maple, oak, and plane trees are much more resistant. Different methods for determining the cause of damage (chemical, botanical, biometric, and histochemical) and methods of plant protection (spraying with lime or special oil emulsions) are briefly described. The need for better control of sources of fluorine pollution is stressed.

46262

Heggestad, H. E.

AIR POLLUTION AND PLANTS. In: Man s Impact on Terrestrial and Oceanic Ecosystems. William H. Matthews, Frederick E. Smith, and Edward D. Goldberg (eds.), Cambridge, Mass., MIT Press, 1971, Chapt. 6, p. 101-115. 53 refs.

Air pollution problems caused by gaseous and particulate pollutants on cultivated plants are reviewed. Agricultural losses due to air pollution are an estimated $500 million annually and are increasing. Most of the loss is due to growth suppression or to chronic injury as indicated by relative growth of plants in ambient air containing pollutants and carbon-filtered air with most oxidants and some other pollutants removed. Photochemical oxidants such as ozone and peroxyacetyl nitrate are considered, as well as ethylene, sulfur dioxide, fluoride, nitrogen dioxide, and other pollutants. The combined effect of two or more gases is discussed, and the significance of environmental factors is reviewed. Research needs are summarized.

46338

Houten, J. G. ten

SOURCE, DISPERSION AND EFFECT OF CHEMICAL AIR POLLUTANTS. (Herkomst, verspreiding en effect van chemische luchtverontreinigingen). Text in Dutch. Inst. of Phytopathological Research, Wageningen (Netherlands), 16p., 1972. 32 refs. (Presented at the Aerobiology Symposium, Wageningen, Netherlands, Jan. 1972.)

The effects of general and specific air pollutants on plants are reviewed. The air pollutants enter into plants through the stomata of the leaves and may cause serious metabolic disorders on a cellular level. Sulfur dioxide causes necrosis of intercostal tissues without affecting the nerves. It has no cumulative effect as it is metabolized into harmless sulfates. Lichens were highly sensitive for SO2. Examples of plant damage and action radii in different areas are given. Ethylene, originating from automotive exhaust, causes epinasty in stomata in a concentration of 0.1 ppm. Nitrogen dioxide in a concentration of 0.25 ppm damages tomato. The effects of ozone formed in photochemical reactions on Pinus ponderosa were detected at a distance of 100 km from the source. Hydrofluoric acid emissions from a aluminum plant caused total destruction of conifers and needle damage up to a distance of 32 km. Cement dust and other solid particles may serve as condensation nuclei for other air pollutants. Reduced virulence of phytopathogenic fungi due to SO2 was observed; 0.5-1 ppm ozone concentrations, maintained over a few hours had a similar effect on Fusarium oxysporum, Colletotrichumlagenarium, Verticillium albo-atrum and V. dahliae. The growth-stimulating effect of acetaldehyde on Sclerotium rolfsi was observed. An air pollution monitoring network of 250 sampling stations, designed to measure SO2 and NO2, nitric oxide, and ozone concentrations is under construction in the Netherlands.

46557

Mooi, J.

INVESTIGATION OF THE SUSCEPTIBILITY OF WOODY PLANTS FOR SO2 AND HF. (Onderzoek naar de gevoeligheid van houtige gewassen voor SO2 en HF). Text in Dutch. Groen, 1972:1-12, Jan. 1972.

The equipment for fumigation of woody plants in the field developed by Spierings was improved by mounting feelers to the fumigation gun in order to measure climatic conditions. The data from these feelers is registered automatically on instruments situated in a van and worked out by a computer. The equipment is used for short-time fumigations in the field. Short-time fumigations were also carried out in the laboratory. The data and symptoms of damage to the trees and shrubs caused by low concentrations of sulfur dioxide and hydrogen fluoride are discussed. In a fumigation experiment with a concentration of 2.41 ppb HF applied during 4 months, trees and shrubs showed a great difference in susceptibility to and capacity for uptake of HF.

46719

Keller, Theo and H. Schwager

THE DETECTION OF HIDDEN F-INJURY OF FOREST TREES BY A SIMPLE COLORIMETRIC DETERMINATION OF PEROXIDASE ACTIVITY. (Der Nachweis unsichtbarer (physiologischer) Fluor-Immissions-schaedigungen an Waldbaeumen durch eine einfache kolorimetrische Bestimmung der Peroxidase-Aktivitaet). Eur. J. Forest Pathol., 1(1):6-18, 1971. 26 refs. Translated from German. 21p.

A simple routine method is described for colorimetrically determining peroxida e activity in foliage of forest trees, including conifers. Peroxidase activity increases with aging of tissues. Fluoride emissions add to this natural tendency, thus leading to premature senescence; the increased fluoride content in assimilation organs is associated with increased peroxidase activity. External dust influences peroxidase activity only after several hours, while peroxidase activity is very little affected by variations in tissue water content. An analysis of potted plants exposed at varying distances from an aluminum plant and fluoride emissions indicates that peroxidase activity and the fluoride content of foliage increases with decreasing distance. Increased peroxidase activity may occur without or before symptoms of visible fluoride injury develop. (Author summary modified)

46721

Schoenbech, H. and W. Hoelte

DETECTION OF AIR POLLUTION BY THE TRANSPLANTED FOLIOSE LICHEN, PARMELIA PHYSODES. (Zum Nachweis von Luftverunreinigungen durch die transplantierte Blattflechte Parmelia physodes). Zentralbl. Bakteriol., Parasitenk. Infektionskr. Hyg.:Abt. 1:Orig., Reihe B, 212(2/4):356-357, Feb. 1970. 1 ref. Translated from German. 2p.

Open air and fumigation studies indicate that the foliose lichen Parmelia physodes reacts to ground level concentrations of sulfur dioxide and hydrogen fluoride, and that it can be measured by the withering of individual thallus parts. Reactions were photographically recorded at predetermined time intervals. An investigation conducted in the vicinity of an aluminum plant ascertained that Parmelia physodes is a quantitatively reacting biological indicator.

46733

Wentzel, Karl Friedrich

INSECTS AS EMISSION-RELATED PESTS. (Insekten als Immissionsfolgeschaedlinge). Naturwissenschaften (Berlin), 52(5):113, 1965. 3 refs. Translated from German. 3p.

An appraisal was made of the degree of conifer foliation in eight test areas lying end-to-end in a radiating pattern from a brick kiln factory and to a distance 1020 m East and Northeast, as well as the accompanying degree of infection from spruce gall lice. Close relationships were found between the degree of damage to the trees and the gall infection. Hydrogen fluoride emissions from the brick kiln can effect a shift in the disposition of the host plants, thus providing conditions for the development of spruce gall lice.

46923

Navara, Jan

VARIATIONS IN THE INTENSITY OF TRANSPIRATION AND DAMAGE TO PLANTS CAUSED BY FLUORINE PRESENT IN THE ATMOSPHERE. (Zmeny v intenzite transpiracie a poskodenie rastlin pri posobeni fluoru z ovzdusia). Text in Slovak. Biologia (Bratislava), 27(7): 545-559, 1972. 30 refs.

The effect of various atmospheric fluorine concentrations on transpiration intensity and the health of leaves of 10-day-old plants of Pisum sativum was studied under conditions of continuous and periodic fumigation. Transpiration intensity was determined gravimetrically by a special apparatus. Low fluorine concentrations (50 ppb), following a temporary drop in water transpiration, resulted in a marked increase in transpiration. Following the attainment of maximal increase, transpiration decreased again to end up shortly before the appearance of visible leaf damage at lower intensity than control plants unexposed to fluorine. Higher concentrations (100-150

ppb) led immediately to a gradual drop of transpiration intensity which continued throughout the stage of invisible and visible leaf damage. Lower and higher fluorine concentrations also affected the appearance of leaf damage. Leaf necrosis appeared sooner at higher, later at lower, fluorine concentrations. At lower concentrations, upper ontogenically younger leaves turned light brown which was followed by peripheral necrosis on fully developed leaves. Concentrations of 150 ppb caused a different type of damage: after one day of fumigation, the leaves began to wilt. Transpiration intensity at high fluorine concentrations dropped more markedly in plants growing at relatively lower humidity, at higher relative humidities the effect of fluorine was less noticeable. Periodic fumigation disclosed that at night plants were more sensitive to the effect of fluorine than during the day: transpiration intensity dropped more.

46997

Bourbon, P., J. Tournut, J. Alary, J. F. Rouzaud, and F. Alengrin

CONSEQUENCES OF SMALL FLUORIDE POLLUTION IN A MOUNTAIN VALLEY. (Consequences d une pollution fluoree de faible importance dans une vallee de montagne). Text in French. Tribune CEBEDEAU (Centre Belge Etude Doc. Eaux), 24(327):62-66, Feb. 1971. 8 refs.

Fluoride content in the air and forage were determined, and symptoms of chronic fluoride poisoning in cattle raised in a mountain valley accommodating a phosphoric acid production plant were studied systematically over 10 years. The plant, processing phosphates with a fluoride content of 3.8%, emitted 20 kg of F daily. The atmospheric average F concentration ranged from zero to 10 micrograms/cu m, with 90% in the form of hydrofluoric acid and silicotetrafluoride, and 10% in the form of apatite. The fluorine content in forage, ranging from 20 to 50 ppm, and up to 164 ppm in one case, is responsible for pathological symptoms of fluorine poisoning in cattle. Fluorine content of about 30 ppm causes discoloration of the dental enamel in cattle fed such forage over more than 3 years, which corresponds to the fluorine residues of more than 1000 ppm in the jawbones. Periodic limping occurs in cattle fed forage with about 50 ppm of F over 5 years, corresponding to an F content of more than 4000 ppm. Such animals lose weight and yield much less milk than normal ones. Caries and loose teeth in cattle whose jawbones contain F residues of more than 3000 ppm are observed. Osteosis is, however, practically nonexistent. The urine F content, ranging from 2 to 20 ppm, was normal with less than 10 ppm in 60% of all animals. The results show an accumulation of F in bones, and suggest an F content of 20 ppm in forage as a safe limit.

47014

Spinka, Josef

EFFECTS OF POLLUTED AIR ON FRUIT TREES AND LEGUMES. (Vliv znecisteneho ovzdusi na ovocne stromy a zeleninu). Text in Czech. Ziva, 19(1):13-15, June 1971.

Plants undergo microscopic and macroscopic changes when exposed to atmospheric sulfur dioxide and chlorine concentration of 1 times 10 to the - 6th power g/cu m. Soil quality also suffers from SO2, Cl, fluorine, and other gases. All plant damage from atmospheric pollutants is intensified by high humidity. Plant damage can best be detected by microchemical methods. Detection of leaf damage from nitrogen oxides or ammonia is difficult because of the high content of other nitrogen compounds. Suspended dust reduces the amount of solar energy available for photosynthesis by reducing the intensity of solar radiation. Maximal short-term and median long-term concentrations tolerated by plants for SO2, carbon monoxide, NOx, Cl, hydrogen sulfide, soot, fluorine, arsenic, phenol, benzene, and ammonia are given. In Czechoslovakia a 12.5 g/sq m/mo dust fall with up to 20% free silicon dioxide is permissible. Emissions of CO, hydrocarbons, NOx, and lead cause damage to crops and trees lining heavily travelled highways.

47286

Daessler, Hans-Guenther

PLANT DAMAGE FROM AIR POLLUTION. (Vegetationsschaeden als Folge der Luftverschmutzung). Text in German. Wiss. Z. Tech. Univ. Dresden, 20(4):1171-1173, 1971.

The problem of air pollution-induced plant damage in East Germany is outlined. Sulfur dioxide causes most of the damage in forestry and agriculture, followed by hydrofluoric acid and silicon tetrafluoride. Dust and soot emissions are less hazardous for forests, while they may cause damage to fruits and vegetables and unfavorably modify soil properties. Arsenic, lead, copper, and zinc emissions are especially harmful since they may result in reduced crops. Invisible physiological, chronic, and acute plant damage due to pollution are distinguished. Exposures over a short time to high pollutant concentrations are generally more hazardous than long-term exposures to low concentrations. The total forest damage area in East Germany is estimated at 220,000 ha. Pollution induced damages of barley and flax, as well as livestock damages due to the consumption of contaminated forage have occurred repeatedly. As the proportion of fossil fuels among the energy sources steadily increases, no decrease in the SO2 level is expected. There are no effective means for controlling SO2 emissions, and the construction of high stacks constitutes no real solution to the emission problem.

47385

Subido, P. S., P. A. Santamaria, E. N. Alqueza, and A. C. Pizarro

PLANTS INJURED BY AIR POLLUTANTS. Philippine J. Sci. (Manila), 98(3/4):323-328, Sept./Dec. 1969. 5 refs.

The effects of emissions from a fertilizer factory on the plant life in the surrounding areas were examined. The typical symptoms and condition of the plants affected by corrosive sulfur dioxide and hydrogen fluoride gases included shrivelling, discoloration, and scorched leaves. Branches and twigs were covered with grayish deposits of fertilizer dusts and other particulates. Defoliation was common. The effect on sweet potato was even more devastating; on the average, a field was completely destroyed within three days. Plant growth of varied species was stunted in several cases. The magnitude of destruction was less near the source of pollution and more intense further away, corresponding to the dispersal of pollutants.

47806

Dinh, Duyen Lai and Guenther Buchloh

THE EFFECT OF FLUORINE EMISSIONS OF POLLEN GERMINATION AND FRUIT GROWTH. (Wirkung von Fluor-Emissionen auf Pollenkeimung und Fruchtwachstum). Text in German. Umweltforschung, no. 58:24-25, 1971. (Presented at the Hohenheim University Umweltforschung Seminar, 1971.)

The effects of the fluorides of sodium, hydrogen potassium, magnesium, calcium, and strontium on pollen, helium, and fruit growth were studied. Univalent fluorides except for HF in concentrations of up to 10 ppm had no effect on the pollen germination and on the helium, and even seemed to beneficial

for germination. Shrinkage in the apical region and skinny degeneration of the epidermis during fruit growth were observed. Such fruits were of reduced size and of unacceptable quality. These and other findings suggest the pollen growth- and germination-inhibiting effect of calcium fluoride.

48022

Wentzel, K. F.

FORESTRY MEASURES AGAINST IMMISSIONS. (Waldbauliche Massnahmen gegen Immissionen). Allgem. Forstztg., vol. 18:101-106, 1963. 12 refs. Translated from German. 32p.

Forest damage can be prevented with certainty only by controlling toxic pollutants before they leave the factories. Thus, the protective measures against pollutants available to forestry are almost exclusively of a prophylactic nature. Their only objective is to prevent major destruction of a forest s structure and character and to maintain a certain capacity of yield and finally any growth at all in the vicinity of industries. Sulfur dioxide and hydrogen fluoride gases cause the most damage to forests. The countermeasures available to forest management are based on three hypotheses: that the tree species, as well as an individual specimen of one species, have different resistances to harmful emissions; smoke plumes dilute more quickly, the more they pass through obstacles and barriers in their path; the more favorable the general conditions of growth are, such as the soil, the more resistant the plant will be to attacks of smoke concentrations. Reforestation with more resistant species, some of which are cited, is discussed, as well as the arrangement of protective belts or smoke barriers and improving the conditions of growth. The selection of seeds and sapling is also considered. Economic problems involved with adapting a forest to the effects of pollution are mentioned.

43167

Leibetseder, Josef, Monika Skalicky, Abdul Hakim Said, Alfred Kment, Erich Glawischnig, and Gerd Schlerka

STUDIES OF THE TOXIC EFFECT OF HAY ON CATTLE IN SMOKE-INJURED AREAS. (Untersuchungen ueber toxische Wirkungen von Heu aus Rauchschadengeibieten beim Rind). Text in German. Z. Erzbergbau Metallhuettenwesen, 25(10):498-505, 1972. 21 refs.

In the vicinity of zinc, lead, and sulfuric acid plants in Arnoldstein, Austria, the extent of injuries to the vegetation by the emissions from these plants was determined. The hay from the smoke-injured area was used for feeding experiments with seven test cows for determination of any possible intoxication through the higher lead, zinc, and fluorine intake with the fodder. With the exception of spots on the teeth of about 1/3 of the test cows, no symptoms of intoxication with these elements could be determined. The feeding experiment lasted 6 months. The lead and zinc concentration of the examined hay was above normal, but below the toxic limit. The fluorine concentrations were on the upper limit of the normal values. Clinical examinations including blood tests carried out at 2-week intervals were negative. The lead and zinc concentrations of blood, blood plasma, feces, urine, milk, and hair were below the toxic range. The fluorine concentration in the bones excluded any fluorine intoxication. The milk production of the test animals, however, was significantly lower by 0.64 l/animal/day (average over the total duration of the feeding experiments), compared to the control animals.

48193

Leibetseder, J., M. Skalicky, A. H. Said, A. Kment, E. Glawischnig, and G. Schlerka

INVESTIGATIONS OF TOXIC EFFECTS ON CATTLE FROM HAY DAMAGED BY INDUSTRIAL SMOKE. (Untersuchungen ueber toxische Wirkungen von Heu aus Rauchschadengebieten beim Rind). Text in German. Erzmetall, 25(10):498-505, Oct. 1972. 21 refs.

Clinical investigations of cattle in a region with industrial smoke and sulfur dioxide hazard, and experimental studies of lactating cows were undertaken. Clinical search and analyses of various enzymes, of the content of the rumen, and of the amount of lead, zinc, and fluorine in feces, urine, milk, and different organs showed no signs of intoxication by the above elements after feeding of damaged hay. However, the milk production was significantly reduced.

48291

Haneda, Mikiko and Fumio Tsunoda

INDICATOR PLANT IN FLUORIDE AIR POLLUTION INVESTIGATION. (Fukkabutsu ni yoru taiki osen chosa no tame no shihyo shokubutsu ni tsuite). Text in Japanese. Nippon Koshu Eisei Zasshi (Japan. J. Public Health), 19(9):449-456, Sept. 1972. 20 refs.

Atmospheric fluoride accumulates in the leaves of some plant species, thus designating them as a fluoride air pollution index. Irises, gladioli, and pines as pollution indicators were tested around an aluminum factory. A very high concentration of fluorine was determined in the upper part of the iris leaf and was in proportion to the actual fluoride air pollution index. A fluorine content of 30-50 ppm (dry weight bases) or 10-20 ppm (wet weight basis) indicated that the air was polluted by fluorides. Similar results were determined for the gladioli and pines.

48374

Stark, Nellie B. and Patricia F. Harris

STUDIES OF TRACE ELEMENTS IN SOILS AND PLANTS FROM THE FOUR CORNERS AREA OF NEW MEXICO. (FINAL REPORT). Nevada Univ., Reno, Center for Water Resources Research, Environmental Protection Agency Contract 68-02-0269, EPA-R4-72-007, Project Rept. 20, 94p., Sept. 1972. 24 refs. NTIS: PB 212561

The concentration of eleven trace elements in plants and soil in the Four Corners area of New Mexico was measured to develop background and preliminary data on the environmental effects of coal-fired power plants in the area and data on the potential buildup of each trace element. The elements included arsenic, beryllium, cadmium, chromium, fluoride, lead, manganese, mercury, molybdenum, nickel, and selenium and were chosen on the basis of the chemical makeup of the fly ash emitted by the power plants. Instrumentation, sample collection and preparation, testing procedures, and results are reviewed. Complete analytical data are presented. (Author introduction modified)

48377

Hasumi, Kunihiko

MODERNIZATION OF HYGIENIC LABORATORY. 2. HYDROGEN FLUORIDE POLLUTION. (Eisei kensa kiko no kindaika ni kansuru kenkyu. II. Kogai taisaku ni okeru jirei no kento to kosatsu). Text in Japanese. Fukushima-ken Eisei Kenkyusho Kenkyu Hokoku (Fukushima Prefect. Inst. Public Health, Rept.), 17(3):27-30, 1969. 8 refs.

In June 1969, damages by hydrogen fluoride to 25 boxes of silk worms (at 10 farms) and damages to mulberry trees covering three hectares of area were reported. The emission source was a glass fiber manufacturing plant in Fukushima City. The fluorine content in the raw material was measured and a maximum of 0.035% to a minimum of 0.002% was detected. The hydrogen fluoride gas was measured on a sunny day. A maximum of 23.3 ppm, a minimum of 19.1 ppm, and an average of 20 ppm of HF were detected. The mulberry leaves within 300 to 500 m of the plant contained 39 to 40 ppm of fluoride, in contrast to those in the control areas, which had 0.9 ppm. Recommendations are made for the planning an air quality monitoring system in relation to equipment, personnel, and information-obtaining method.

48403

Comeau, Gilberte and Fabius LeBlanc

EFFECT OF FLUORINE ON FUNARIA HYGROMETRICA AND HYPOGYMNIA PHYSODES. (Influence du fluor sur le Funaria hygrometrica et l Hypogymnia physodes). Can. J. Botany, 50(4):847-856, 1972. 23 refs. Translated from French. 24p., 1972.

Two species of cryptogams were fumigated with hydrofluoric acid to determine their degree of sensitivity to atmospheric fluorine by direct observations of symptoms of chlorosis and necrosis in the leaves; the extent of accumulation of fluorine in the plants and their capacity for recuperation after the fumigation process. The fumigation process consisted of treatment with 13, 65, and 130 ppb HF for 4, 8, and 12 hours and then 13 ppb for 36, 72, and 108 hours. At concentrations of 65 ppb/12 hr, the moss and lichen showed chlorotic spots; some of the chloroplasts started to disintegrate; and plasmolysis occurred. After three weeks of recuperation, the Funaria hygrometrica lost 26-36% and the Hypogymnia physodes lost 36-47% of the fluoride accumulated.

48413

Bossavy, J.

AIR POLLUTANTS AND THEIR EFFECTS ON PLANTS. (Les polluants atmospheriques, leurs effets sur la vegetation). Ann. Gembloux, no. 77:163-173, 1971. Translated from French. 14p.

The effects of air pollutants on plants are reviewed with respect to types of air pollutants, symptoms of damage, and species affected. Plant damage was surveyed in France, East and West Germany, Austria, Greece, the Netherlands, Norway, Poland, Rumania, Sweden, Switzerland, Turkey, and Czechoslovakia. The pollutants of greatest concern with respect to plant damage included fluorine compounds, sulfur compounds, especially sulfur dioxide, smoke, ethylene, and metal compounds. Some emission sources are also discussed.

48556

Kaneda, K., R. Sugai, Y. Fujieda, and E. Abe

ATMOSPHERIC POLLUTION BY FLUORIDE AND ITS INFLUENCE ON PLANTS. (Fukkabutsu ni yoru taikiosen to shokubutsu eikyo). Text in Japanese. Nippon Koshu Eisei Zasshi (Japan. J. Public Health), 19(10):423, Oct. 1972. (Presented at the Japan Society of Public Health, General Meeting, 31st, Sapporo, Japan, Oct. 25-27, 1972.)

Atmospheric fluoride concentrations were measured from May 1969 to March 1972 for each month by the limus and alkali filter paper methods. The growth of potted gladioli at 11 spots near two factories (phosphate fertilizer and an aluminum refining factory) was measured in 1969, of rice at 30 spots in 1970, and of cedar trees at 38 spots in 1971. Gladioli growth was measured at 10 spots; at two spots with high fluoride concentration, the leaf color change, retardation of height and number of leaves, and other significant differences were observed. At 1 km from the factory, the plant growth rate decreased. Cedar trees, checked at 37 spots except for nine contrasted spots, revealed some damage. Some correlation was found between atmospheric fluoride concentation and more fluorine quantity in the leaves.

48639

Yamazoe, Fumio

THE EFFECT OF AIR POLLUTION ON AGRICULTURE AND FORESTRY. (Taiki osen ni yoru norin kogai). Text in Japanese. Nogyo Oyobi Engei (Agr. Hort.), 48(1):133-138, 1973. 6 refs.

The effect of hydrogen fluoride on plants is stronger than on animals. The threshold value of indicator plants (gladioli) is 5-10 ppb/day. The HF can cause etiolation at the tip or fringe of leaves. Silkworms fed leaves polluted by over 30 ppm of HF became ill. Cows exhibit fluorosis effects in teeth and bones after HF exposure. Chlorine turns leaves yellow by causing decomposition of chlorophyll. Plant damage occurs after 2-4 hr of exposure to 0.05-0.07 ppm of ozone or after 8 hr of exposure to 0.05 ppm of peroxyacetyl nitrate. Ozone causes white or brown spots on the surface of leaves; peroxyacetyl nitrate causes silver or bronze spots.

48798

Boertitz Siegfried and Horst Ranft

ON THE SUSCEPTIBILITY OF LICHENS AND MOSSES TO SO2 AND HF. (Die SO2 und HF-Empfindlichkeit von Flechten und Moosen). Text in German. Biol. Zentralbl., 91(5):613-623, 1972. 16 refs.

The assimilation of 20-25 different types of mosses and lichens exposed to sulfur dioxide and hydrogen fluoride containing air was studied. For the assimilation measurements with the carbon dioxide URAS, the samples were put into glass cuvettes. For a study of the externally visible injuries, the sample material was exposed for 36 hours to 3.5-5.5 mg SO2/cu m air and for a period of 27 hours to 0.3-0.4 mg HF/cu m. During the four to five days of exposure the weather was cloudy with showers. The noon temperatures were between 6 and 10 C. A sunny afternoon at the end of the experiments accelerated the development of visible damages. The exposure to phytotoxic substances such as SO2 and HF does not immediately produce visible injuries. These substances gradually are retained in the plant tissue; moreover they are capable of reversibly or irreversibly influencing the photosynthesis. The assimilation intensity diminished during fumigation and gradually picked up again afterwards, provided the assimilation apparatus was not irreversibly damaged. With several lichens and mosses the visible injuries did not correspond in any way to the damages of the assimilation organism. The physiological dynamics prior to the occurrence of visible damage showed no fundamental difference in lichens from higher plants affected by phytotoxic substances.

48941

Kanagawa Prefecture Agriculture Experiment Station (Japan)

THE EFFECT OF AIR POLLUTION ON PLANTS-THE FLUORINE CONTENT IN STREET TREES. (Jumoku ni taisuru taiki osen no eikyo-Gairoju-yo no fusso ganryo). Text in Japanese. Kanagawa-ken Taiki Osen Chosa Kenkyu Hokoku (Tech. Rept. Air Pollution Yokohama- Kawasaki Ind. Area), no. 14:87-92, Feb. 1972.

Leaves of street trees in Kawasaki and Yokohama cities were collected in 1967. The maximum value of the content of fluorine in the leaves was 1653 ppm, the minimum value was 22 ppm and the average value was 135 ppm. There was a regional difference in the fluorine content in leaves between an industrial area and a commercial or residential area. The fluorine content in leaves of an industrial area and a commercial or residential area was in the ratio 10 and 2 or 3. There was a mutual relationship between the value of sedimented dust in the air and the content of sulfur oxides in air and the content of fluorine in leaves. The relationship between the fluorine content and the sulfur content in leaves and the relationship between the fluorine content in leaves and insoluble substances stuck to the leaves was not clear. The fluorine content in the soil was between 108 and 504 ppm, and the average content was 240 ppm.

49316

Oelschlaeger, Walter

EMISSIONS AND THEIR EFFECTS ON CATTLE. (Immissionen und ihre Wirkung auf landwirtschaftliche Nutztiere). Text in German. Umweltforschung, no. 58:26-29, 1971. (Presented at the Seminar on Environmental Research, Hohenheim University, Stuttgart, West Germany 1971.)

Cattle is mainly affected by two air pollutants, fluorine and lead. The fluorine emissions are largely under control due to regulations. With the number of automobiles increasing, the lead is increasing in the vicinity of highways. Although the lead concentration in fodder grown along highways is considerable, the concentration drops quickly with increasing distance from the highway. Cattle are not so much affected by this pollutant, since they are not fed with fodder of this kind all year round. The concentrations of these pollutants in living animals is still rather low so that there is no danger for humans ingesting the meat from such cattle. Milk could be an exception in this respect provided the animal was acutely exposed to lead.

49434

Tsunoda, Fumio, Hiroko Kunida, Yoshizo Sato, Kazuo Sasaki, Yuzo Kawarada, Isao Kimura, Morio Murakami, Hifumi Shioi, and Takenori Yoshida

CASE STUDY OF THE DISSECTION OF A CATTLE RAISED IN FLUORIDE POLLUTION FOR 30 MONTHS. (Fukkabutsu ni yoru taiki osen kankyoka ni sanjikkagetsu shiiku shita ushi no bokenrei). Text in Japanese. Japan Society of Air Pollution, Proc. Symp. Japan Soc Air Pollut., 13th, 1972, p. 200. (Nov. 7-9, Paper 155.)

Cattle raised for 30 months in an environment polluted by average of 1 ppb of fluoride and feed containing 40-60 ppm fluorine were slaughtered and dissected. There were no visually detectable anomalies. The blood test conducted immediately before slaughtering showed no anomaly in blood chemistry; liver and kidney functions were also regular. Histopathologically, slight irregularities were recognized in teeth and bones, but the heart, lungs, trachea, brain, liver, kidneys, spleen, glands, and other organs had no abnormalities. The fluorine content in all the organs were normal; high F content was noted in urine, plasma, bones, and teeth. The fluorine content in the skull was 4984 ppm; jaw 5069-5311; vertebrae 4826 to 5629; ribs 3900 to 5163; bones of the lower limb 5142; and teeth 2653 to 4889. The bones of the cattle were in the process of chemical fluorosis or bone fluoridation, or in the process of bone mottling, had not developed into abnormal bone formation.

49561

Bovay, E.

INDUSTRIAL FLUORINE EMISSIONS: THEIR EFFECTS ON PLANTS AND ANIMALS. (Les emissions fluorees industrielles: leurs effets sur les plantes et les animaux). Text in French. Pract. Environ. Control, Proc. Int. Congr. PRO AQUA-PRO VITA, Basel, Switzerland, 1971, p. 163-184, 1972. 80 refs.

Emissions of fluorine compounds from metallurgical and chemical factories, particularly aluminum factories and phosphate fertilizer plants, are a source of pollution of a high grade of causticity with regard to vegetables, for very weak fluorine concentrations in the air, in the range of 1 microgram hydrogen fluoride/cu m of air. Some plants are even more sensitive to the effects of fluorine compounds, like apricot trees, vines, barberry, gladioli, the Liliaceous species in general, pine trees, Norway spruce, and other forest trees. These sensitive species form typical necroses on the edge or at the tip of the leaves for fluorine contents in the dry matter lower than 50 mg/kg. The topographic situation of the factories plays an important part in the diffusion of gases. Fluorine intoxication (fluorosis) of animals originates most frequently from the absorption of fluorine compounds in fodder which originate from volitile F compounds issued by certain metallurgical and chemical factories. The symptoms of fluorosis include mottling and wearing of teeth, osteofluorosis, high fluorine content of bones and urine, and secondary effects like limeness and reduced milk production. The fluorine content of the total daily diet of milk cows should not exceed 30 mg/kg dry matter. Factories emitting F have generally taken precautions to reduce these emissions to 10-15%; however, a larger reduction must be reached in areas with highly F-sensitive plants.

49573

Sato, Y. and Y. Tsuji

FLUORIDES INFLUENCE ON FERTILIZATION AND APPEARANCE IN EARLY STAGES OF SEA URCHINS. (Uni-ran no jusei oyobi hassei shoki ni yaisuru fukkabutsu no eikyo). Text in Japanese. Nippon Koshu Eisei Zasshi (Japan. J. Public Health), 19(10):427, Oct. 1972. (Presented at the Japan Society of Public Health, General Meeting, 31st, Sapporo, Japan, Oct. 25-27, 1972.)

The eggs and spermatozoa of sea urchins were used to observe fluoride s influence on fertilization. Additions of 5, 10, 25, 50, 100, 125, 250, 375, and 500 mg (F concentration: 22.6, 45.2, 113.0, 226,0, 452.0, 565.0, 1130.0, 1695.0, and 2260.0 ppm, respectively) were made to normal sea water of 100 ml. They were used as test groups and were compared with a control group. The rate of fertilization and state of appearance were judged from photographs. The fertilization rate was near 100% in the 0-250 mg groups and below 10% in 375-500 mg groups. The difference in the deposition time of eggs which were laid in the testing liquid prior to fertilization did not seem to affect the fertilizing rate. Three hours after the fertilization, eight-cell-terms were the majority in the 25-250 mg groups and 4-cell-terms showed a high rate in the 50-250 mg groups. Normal pluteus appeared in the control group after 48 hours and were also seen in the 5 and 10 mg groups at 88 and 30% rates, respectively. But embryoes in 25-250 mg groups which are supposed to grow to normal pluteus did not appear at this moment. After 72 hours from the fertilization, embryoes which started forming born structure were seen in each of the 0, 5, and 10 mg groups, also the abnormal born structure appeared in each of those groups at 30, 8, and 11% rates, respectively. Further, abnormal embryoes were observed in all groups, especially with an extremely high rate in the 25-125 mg groups. Main stages of the process are shown in tabulations, graphs, and photos.

49644

Godzik, Stefan and Zdislaw Piskornik

THE EFFECT OF AIR POLLUTION ON PLANTS. (Oddzialywanie zanieczyszczen powietrza na rosliny). Wiad. Bot., 13(4):239-248, 1969. 102 refs. Translated from Polish. Leo Kanner Assoc., Redwood City, Calif., 16p., Nov. 1972.

The effect of air pollution on plants is reviewed. Pollutants discussed included sulfur dioxide, hydrogen fluoride, fluorine and its compounds, nitrogen oxides, ozone, chlorine and its compounds, and ammonia. The sources of each of these pollutants, their specific properties, and their effects are listed. Plant damages elicited by air pollutants are divided into acute damage, chronic damage, and invisible damage. Changes occurring during plant injury are described.

49647

Haertel, O.

ECOPHYSIOLOGY AND ANTHROPOGENIC ENVIRONMENTAL CHANGES. (Oekophysiologie und anthropogene Umweltveraenderungen). Ber. Deut. Bot. Ges., 84(9):497-506, 1971. 34 refs. (Presented at the Botanists Convention, Innsbruck, Austria, Aug. 31, 1971.) Translated from German, 17p.

The effects of human influences on the environment and their results are discussed. Effects on the environment which are becoming more perceptible are the results of two circumstances: concentration in preferred living areas; and the capability of Man to satisfy his civilizing demands in steadily increasing measure, according to his technical capabilities. Encroachments on the environment are direct and indirect: direc through producing the necessary dwelling, cultural, and civic areas; and indirect through waste products, and especially through those of the technological civilization Man has produced. The greater demand for soil, removal of vegetation, the use of fertilizers and insecticides, and the depletion of soil nutrients in relation to unbalancing the original state are considered. Harmful pollutants stemming from industry and the increased use of motor vehicles, including sulfur dioxide and fluorine compounds are reviewed. Photooxidation products such as ozone, the main components of smog, carbon dioxide, and their effects on plants are also reviewed.

49704

Shupe, James L. and Arland E. Olson

CLINICAL ASPECTS OF FLUOROSIS IN HORSES. J. Am. Vet. Med. Assoc., 158(2):167-174, Jan. 15, 1971. 12 refs.

Clinical aspects of fluorosis in horses are described. Horses grazing in areas where cattle and sheep had developed severe fluorosis were examined clinically. Major fluorotic lesions occurred only when the horses ingested excessive amounts of fluorine during the period of tooth formation. Dental fluorosis with excessive premolar and molar abrasions, and osteofluorotic lesions, such as porosis, sclerosis, hyperostosis, osteophytosis, and malacia, were observed. Fluorosis was due to the ingestion of vegetation contaminated with airborne particulates and gaseous affluents high in fluorine. Therapy is described.

49778

Heggestad, H. E. and W. W. Heck

NATURE, EXTENT, AND VARIATION OF PLANT RESPONSE TO AIR POLLUTANTS. Advan. Agronomy, vol. 23:111-145, 1971. 154 refs.

Nature, extent, and variations of plant response to air pollutants are reviewed. The most common phytotoxic air pollutants in the USA are ozone, sulfur dioxide, fluorides, peroxyacl nitrates, ethylene, nitrogen dioxide, pesticides, chlorine, heavy metals, acid aerosols, ammonia, aldehydes, hydrogen chloride, hydrogen sulfide, and particulates, such as cement dust. Ozone and SO2 are widely distributed. In the USA, ozone seems to be causing more plant damage than any other air pollutant, but on a worldwide basis, SO2 is more injurious than ozone. Air pollution problems have increased because of multiple sources and mixtures of pollutants. There is increased concern about chronic injury and reduced growth attributed to air pollutants, such as photochemical oxidants and sulfur oxides. Ozone causes small necrotic spots on the upper surface of the leaves, PANs induce undersurface leaf injury in the form of glazing, silvering or bronzing, and SO2 exerts usually bifacial and interveinal attack with relatively large collapsed areas surrounding the larger green veins. Fluorides cause injury of leaf tip and margins. The effects of nitrogen dioxide resemble those of SO2 in acute incident. Response to pollutants may be altered by many factors, such as genetic, environmental, cultural conditions, time-concentration relationships, and the presence of mixtures of pollutants. The identification and use of tolerant varieties, including resistant varieties developed by breeding, will help reduce losses and assure maximum agricultural production.

49779

Shaw, W. C., W. W. Heck, and H. E. Heggestad

ROLE OF AGRICULTURE IN AIR POLLUTION AND CONTROL. Options Mediterr., no. 9:63-69, Oct. 1971. 12 refs. (Presented at the Agricultural Research Institute, National Academy of Sciences, Annual Meeting, 19th, Arlington, Va., Oct. 13-14, 1970.)

General problems of air pollution-afflicted damages to agriculture are described. The most important toxic air pollutants that originate primarily from nonagricultural sources and that affect agriculture include ozone, sulfur dioxide, peroxyacyl nitrates and other oxidants, ethylene and other hydrocarbons, fluoride, chlorine, hydrogen chloride, nitrogen oxides, heavy metals, particulates, acid aerosols, ammonia, aldehydes, hydrogen sulfide, carbon monoxide, pesticide and other chemical wastes, and radioactive chemicals. Annual damage to agricultural crops and livestock is estimated at more than 0.5 billion dollars, and it is increasing each year. Current agricultural research is concerned with the development of chemical and bioassay techniques to detect the kinds, and measure the quantities of chemical pollutants in the air. Effects of pollutants on plants and animals are being determined. Chemical air pollutants that are being investigated include ozone, sulfur compounds, ethylene, peroxyacyl nitrates, fluorides, nitrogen oxides, chlorine, and automobile exhaust mixtures. Sites of action, mechanisms of action, and the fate of pollutants in plants, animals, and the environment are discussed. Current emphasis is also on research to determine crop yield and quality reductions under field conditions, to understand the influence of climatic, edaphic, and genetic factors as they relate to plant and animal susceptibility, and to develop biological indicators of pollutants. The effects of airborne herbicides, defoliants, desiccants, growth modifiers, nematicides, fungicides, and insecticides on plant growth are also being studied.

50157

STUDIES ON THE MEASUREMENT METHODS OF DAMAGE TO AGRICULTURAL PRODUCE BY AIR POLLUTION. (Taiki osen ni yoru norin sakumotsu higai no sokutei hoho ni kansuru kenkyu). Text in Japanese. Nogyo Gijutsu Kenkyusho Hokoku A, 1972:56-60, Sept. 1972. (Presented at the

Conference on Agriculture, Forestry, and Marine Product Technology, Japan, 1972.)

Studies were made on the effects of air pollution on plants and agricultural produce, starting in 1968. In 1971, the research programs included the relationship between the absorption of toxic gases in plant leaves and the wind velocity, sunshine, and the conditions of the leaf surfaces; the distribution of sulfur in the plant which has absorbed sulfur dioxide; the morphological analysis by equipment of the damaged plants and radiochemical studies; the effects of sulfur dioxide on the growth of vegetables, fruit, and plants; the sulfur content in the leaves; the explanation of the damage mechanism and metabolic changes of plants exposed to SO2; the analysis of plant damages by hydrogen fluoride and ozone and the distribution of these pollutants in the plants. The seasonal fluctuation of susceptibility of plants to pollutants varied by various species. The susceptibility of certain kinds of adhesive mosses proved useful in measuring the degree of air pollution. The distribution pattern of the moss proliferation throughout city was used as an indicator of SO2 pollution, and a map was formulated. The plants do not respond to automotive exhaust gases as clearly as they do to SO2.

50163

Kuribayashi, Shigeharu

INFLUENCE OF AIR POLLUTION WITH FLUORIDE ON SERICULTURE. (Fukkabutsu ni yoru taiki osen no yosan ni oyobosu eikyo). Text in Japanese. Nihon Sanshigaku Zasshi (J. Sericult. Sci. Japan), 41(4):316-322, Aug. 1972. 86 refs.

The effects of fluoride on mulberry leaves and silkworms are reviewed. Fluorine emission sources are discussed. The damage symptoms of mulberry plants vary by degrees, but main characteristics include tip burn, chlorosis of leaves from the edges toward the center, withering, warping, and dropping of leaves. Mottling, banding, and the appearance of shininess or a white powder-like substances are some other symptoms. The normal F content in mulberry leaves is 10-20 ppm. When exposed in 1.5 ppb hydrogen fluoride for 118 hr, no visual damage appears; but further exposure for 212.6 hr will cause visual damages. For a slow accumulation of F, the leaves show a relatively high tolerance, and the F content in the leaves can be as high as 273 ppm when the damages begin to show. When exposed to 5 ppb gas for 40.6 hr, visual damages appear, and the F content can be as high as 213 ppm. A vast variety of damages and concentrations are reported. Silkworms can be damaged either by the consumption of high concentrations of the F in mulberry leaves, or by accumulation of F by consumption of low concentrations of F over a long period. The damage mechanism is not clear, but F seems to suppress the enzyme function and disrupt the respiration of the body system. An acute poisoning usually causes inactivity and death. Chronic effects can delay the growth of the silkworm, or cause lack of sleep, softening of the body, decrease of weight, formation of knots, black mottles, or virus. The tolerance of silkworms for F is usually in the range of 24 to 40 ppm (in dry mulberry leaves).

50415

Yamazoe, Fumio

INJURY TO PLANTS EXPOSED TO FLUORIDES. (Fukkabutsu ni yoru shokubutsu higai to sono jittai). Text in Japanese. Kogai to Taisaku (J. Pollution Control), 9(4):331-338, April 1973. 6 refs.

Fluoride emission sources, emission standards, plant damage, plant resistance, damage factors, damage characteristics and mechanisms, the evalution method for F damage, and the control or attenuation method for F damage are discussed. Plant leaves which absorbed fluoride generally turn yellow on the tips and around the edges; when the roots absorb F, a slighter degree of discoloration and withering occur. Silicicolous plants such as rice and wheat form a compound of silicon and F which is relatively insoluble, and calcicolus plants such as soybeans and colza seed form a compound of calcium and F which is also insoluble. These compounds stay in fixed locations. Toxic hydrogen fluoride solutions destroy the cell system and do not transfer to other locations. They usually damage the metabolism; evaporation of water increases temporarily and then decreases; chlorosis occurs and further develops into necrosis; thee respiration increases temporarily but gradually decreases; the assimilation of carbon and nitrogen decreases: and the balances of various elements are completely destroyed. The control or attenuation methods for F damages are: the use of an evaporation control agent such as water, lime emulsion, or OED; cultivation of other species with a greater resistance against F damages; improvements of fertilizer and care, avoiding nitrogen fertilizers and replacing them with potassium fertilizers; and planting a buffer area with smoke-resistant trees such as camillia, acacia, or phoenix trees.

50503

Yatazawa, M., M. Kadota, and S. Ono

FLUORINE CONCENTRATION IN ENVIRONMENTAL SAMPLES MEASURED BY IRRADIATION SYSTEM. (Kokaku hanno-ho ni yoru kankyo shiryo-chu no fussoryo). Text in Japanese. Kankyo Hoken Reporto (Environ. Health Rept.), no. 8:29-30, 1972.

Fluorine in plants and soil can be measured up to 0.005 ppm by an irradiation method with a + or - 8% precision rate. Fluorine is trapped with sodium hydroxide-sodium oxide, and an anion exchange method is used for pretreatment. Then a F(19)/F(18) reaction is used and the radioactivity of F(18) is measured by a gamma spectrometer.

50505

Yatazawa, M. and S. Ono

QUANTITATIVE MEASUREMENT OF FLUORINE BY IRRADIATION SYSTEM. (Kokaku hanno ni yoru fusso no teiryoho). Text in Japanese. Kankyo Hoken Reporto (Environ. Health Rept.), no. 8:7-8, Jan. 1972.

An irradiation analysis of fluorine in plants and soils is described. The detection limits were 0.41 micrograms carbon(11), 0.17 micrograms nickel(13), 0.17 micrograms oxygen(15), 43 micrograms sodium(22), 0.069 micrograms chlorine(34), and 0.003 micrograms fluorine(18). The detection limit of chlorine is low compared to fluorine. Since chlorine can interfere with fluorine, isolation by gamma irradiation is required. This method can be used to determine small quantities of fluorine.

50677

Garber, K.

THE DIFFERENTIAL DIAGNOSIS OF FLUORIDE DAMAGE TO PLANTS. Fluoride Quarterly J. Intern. Soc. Fluoride Res., 6(1):33-40, Jan. 1973. 30 refs. (Presented at the International Society for Fluoride Research, Annual Conference, 4th, Hague, Netherlands, Oct. 24-27, 1971.)

Fluorides, sulfur dioxide, hydrochloric acid, chlorine, nitrogen dioxide, ammonia, tar fumes, and ozone are toxic to plants. Not all symptoms point to the effect of a particular pollutant.

For the diagnosis of plant damage caused by air pollutants, the most important criterion is the chemical analysis of leaves in conjunction with the examination by ultraviolet light of quartz lamps and the analysis of air and rain water. (Author abstract modified)

50729

Reusmann, G. and J. Westphalen

AUTOMATIC DETERMINATION OF LEAD, ZINC, CADMIUM AND COPPER IN PLANT MATERIALS BY STRIPPING VOLTAMMETRY. (Automatische Bestimmung von Blei, Zink, Cadmium und Kupfer in Pflanzenmaterial durch Inversvoltammetrie). Text in German. Z. Anal. Chem., 264(2):165-167, 1973. 4 refs. (Presented at the Tagung Euroanalysis I, Heidelberg, West Germany, Aug. 8-Sept. 1, 1972.)

During the automatic determination of lead, zinc, cadmium, and fluoride in plants by stripping voltammetry, the ashed plant material is fused with sodium hydroxide. Afterwards hydrochloric acid and citric acid is added, and a pH value of 3.7 is adjusted. For the determination of copper, the sample is acidified with perchloric and citric acid. Then a pH value of 2.7 is adjusted. It is possible to carry out several determinations of lead in plant materials with only one drop of mercury. The limit of detection is 1-3 ppm.

50780

Dept. of Agriculture, Forest Service

OUR AIR: UNFIT FOR TREES. NE-INF-14-72 REV, 23p., 1972.

Major sources of air pollution, pollutants, and their effects on trees are reviewed. Effects depend on type of tree, genetic make-up, stage of growth, nearness to pollutant source, pollutant concentration, and the pollutant duration. A list is presented which includes the known responses of both hardwood and softwood trees to sulfur dioxide, hydrogen fluoride, ozone, nitrogen oxides, peroxyacetyl nitrate (PAN), ethylene, chlorine, hydrogen chloride, and mercury vapor.

50959

Kerin, D.

ANALYSIS OF THE CONCENTRATION OF TRACE SUBSTANCES IN PLANTS IN THE FIELD OF ENVIRONMENTAL POLLUTION. (Die Bewertung des Spurengehaltes der Pflanzen auf dem Gebiet des Umweltschutzes). Text in German. Proc. Simp. Int. Agrochim. Fitonutriz. Oligominerale, Punta Ala, Italy, 1972, p. 283-288. 5 refs. (Oct. 2-6.)

Plants and soil samples taken in the vicinity of metallurgical plants were analyzed by spectrophotometry and atomic absorption. The iron concentration is spruce and pine needles from the vicinity of a steel plant ranged from 200 to 700 mg Fe/kg dry substance. More than 40% of the examined samples had an iron concentration of 400 mg/kg or higher. The iron concentration in needle samples from a non-industrial area ranged from 65 to 190 mg Fe/kg dry substance. Iron and manganese concentrations of needle samples from the vicinity of a steel plant were considerably higher than from an non-industrial environment. The same is true for sulfur and fluorine. The lead concentration of pine needles from non-industrial area measured 3 mg Pb/kg. In the vicinity of a lead plant concentrations of up to 1100 mg Pb/kg were measured. The lead concentration of hay measured 1700 g Pb/kg, in non-industrial areas the average concentration measured was 5.26 mg/kg. Other examples are discussed concerning zinc.

51109

Pellissier, Marc

ATMOSPHERIC POLLUTION AND ITS EFFECTS ON VEGETATION. (La pollution atmospherique et ses effets sur la vegetation). Ministere de la Protection de la Nature et de l Environnement (Quebec) and Quebec Univ., Trois-Rivieres (Quebec), Joint Pub., 1972. 5 refs. Translated from French, 51p.

The effect of air pollution on vegetation and the air quality in the Canadian industrial regions of Shawinigan, Grand-Mere, Trois-Rivieres, and Cap-de-la-Madeleine were investigated. The major emissions in the areas were traced to their sources, and the industrial processes and controls were examined. Pollutants of greatest interest due to their toxic effects on vegetation were sulfur dioxide, fluorine and chlorine compounds, particulates, and hydrogen fluoride. The general effects of the pollutants on vegetation were reviewed, and damages to vegetation characteristic of each region were studied with respect to plants affected, sensitivity ratings, and symptoms of damage. The Shawinigan area was the most affected by air pollution, followed by Cap-de-la-Madeleine, Trois-Rivieres, and Grand-Mere. The major symptoms, detected in various degrees on the leaves and needles of trees, included necrosis, defoliation, burns, chlorosis, and spotting.

51271

Garrec, J. P., R. Bligny, A. Bisch, and A. Fourcy

ACCURATE FLUORIDE DETERMINATIONS THROUGHOUT POLLUTED FIR NEEDLES. Fluoride, 6(2):73-78, April 1973. 10 refs.

Fluoride analyses were made of the surface tissues of polluted needles of fir trees by using microanalysis by proton nuclear reaction. Two distinct peaks of fluoride accumulation were established. The first in the extreme tip of the needle s necrotic area, and the second in the narrow strip which separates the healthy from the injured tissue. The magnitude of these two accumulations and the distribution of fluoride throughout the needle is related to the age of the needle. The amounts of fluoride differ depending upon which side of the needle is measured, the upper surface takes up more fluoride than the lower one. (Author abstract modified)

51321

Treshow, Michael

AIR POLLUTION AS AN ECOLOGICAL FACTOR. Clean Air, 6(3):41-43, Aug. 1972. (Presented at the International Clean Air Conference, 1972.)

The air environment is vital to the health and welfare of man and to the health of plants. Thousands of acres of forest watersheds in Europe and North America have been blighted by sulfur dioxide emissions from smelters and power plants. Fluorides, particularly from aluminum plants and the phosphate industry, have also been destructive to natural areas. The current threat to forests and crops alike is mainly from automobile exhausts. When acted on by ultraviolet light, the emissions react photochemically to form ozone and peroxyacetyl nitrate which are highly toxic to many plant species. In California, more than 150,000 acres of Ponderosa pine have been damaged by oxidants, while herbs that protect land from erosion and are vital to maintaining the nutrient balance of the soil may have been killed off. Desert ecosystems may also be sensitive to the pollutants emitted by hugh coal-burning power plants being built in the Southwest. If society is willing to take action and pay the price, the technology for reducing industrial emissions to harmless levels is available. The standards set

and attainable are adequate to protect man and plants. However, two problems persist: control of emissions from transportation sources, and compelling the use of known control technology on a world-wide basis.

51470

Cormis, L. de

ATMOSPHERIC POLLUTION AND VEGETATION. (Zanieczyszczenie atmosfery a roslinnosc). Air Conserv. (English translation from Polish of: Ochrona Powietrza), 4(5):22-31, 1970. (Presented at the French- Polish Symposium on Air Pollution Control, Paris, France, Nov. 17-21, 1969.) NTIS: TT 70-P55124/5

The effects of sulfur dioxide and fluorine compounds on vegetation were studied in two regions characterized by different topographies and climatic conditions. The relative susceptibilities of various plant species to SO2 were investigated in a spacious valley, with little or no wind and a high frequency of fog, where the major emission source was coal and heavy oil combustion and natural gas refining. The effects of SO2 were characterized by interveinal necrosis, blotches, and defoliation. The effects of fluorine compounds, particularly hydrogen fluoride, were observed in narrow valleys with shifting wind patterns where aluminum smelters were the major source of pollution. The essential feature of fluorine action was the progressive development of the necrotic zone. Plant indicators were discussed.

51484

Carlson, Clinton E.

FLUORIDE IN VEGETATION NEAR A PHOSPHOROUS MANUFACTURING PLANT IN THE VICINITY OF BUTTE, MONTANA. Insect Dis. Rep., no. 70-3:1-5, Feb. 1973. 2 refs.

The fluoride content of vegetation at seven sites near a Butte, Montana, phosphate facility was determined with a specific ion probe. Amounts ranged from 9.4 ppm in Douglas fir foliage to 74.2 ppm in crested wheatgrass foliage. All but two analyses showed more than 10 ppm fluoride, the control level established at Columbia Falls. The State standard of 35 ppm for fluoride in plants was exceeded at three sites within one mile of the facility. No visible symptoms of fluoride injury were observed on coniferous foliage.

51526

Bohn, Hinrich L.

SOIL ABSORPTION OF AIR POLLUTANTS. J. Environ. Quality, 1(4):372-377, Oct.-Dec. 1972. 79 refs.

The mechanism and rates of the absorption of various air pollutants by soil are reviewed with respect to particulate air pollutants, including nickel, cadmium, lead, arsenic, copper, beryllium, zinc, and mercury; and gaseous air pollutants, including sulfur dioxide, carbon monoxide, nitrogen oxides, oxidants (chlorine, ozone, and peroxyacetyl nitrate), hydrogen sulfide, mercaptans, aldehydes, hydrocarbons, fluorine compounds, phosphorus compounds, and acidic gases and mists (hydrogen chloride, sulfuric acid, phosphoric acid, nitric acid, and hydrogen fluoride). Soils absorb organic gases faster and in greater amounts with increasing molecular weight and increasing number of nitrogen, phosphate, oxygen, and sulfur groups in the compound. The absorption of lower molecular weight and less-substituted organic gases depends on the buildup of an appropriate microbial population. The absorption of inorganic air pollutants is primarily by chemical and physical means and involves oxidation and other chemical reactions. (Author abstract modified)

51754

Kanagawa Prefecture Agricultural Experiment Station (Japan)

COOPERATIVE STUDIES ON THE EFFECTS OF AIR POLLUTANTS ON GARDEN PLANTS (I). (Taiki osen busshitsu ga engei sakumotsu nado ni kansuru kenkyu seisekisho (I)). Text in Japanese. 136p., Feb. 1972.

Cooperative studies were conducted on the general effect of air pollution throughout Kanagawa Prefecture. Studies included periodical measurement of pollutants, plant damage examinations, evaluations of plant indicators, and measurement of sulfur, heavy metals, and fluorine. Gingko and pine were chosen as general plant indicators, and as area representatives, mulberry leaves from the north, pear and grape leaves from the center, and orange leaves from the western part of of the Prefecture were selected. Gingko and pine samplings in Kawasaki were extremely unhealthy in appearance, compared to those from suburban Kawasaki, and the northern, central, western, and coastal areas. The S content in leaves was extremely high in Kawasaki, and a particularly high ratio of nonsoluble S was noted. In all categories of metals, samples from Kawasaki had the highest content, but other than that, generally leaves from the western part of the Prefecture had high counts of iron, zinc, copper, nickel, lead, and manganese. The average fluorine content in leaves was 135 ppm, 22 ppm minimum, and 1653 ppm maximum. The differences by locations and tree specimens were extremely high. If the F index of leaves in the industrial area is considered to be 100, those in commercial, residential, and agricultural areas were less than 20-30. There was a correlation of 0.711 between F and S content of gingko trees. There was an extremely close correlation between the F content of leaves and the amount of settling particles and sulfur oxides concentration in the air. The F content in the leaves increased with the season; at the peak, it reached three to eleven times the amount in new leaves in May.

51905

Gerdes, Raymond Allen

EFFECT OF ATMOSPHERIC HYDROGEN FLUORIDE UPON DROSOPHILA MELANOGASTER. Texas Agricultural and Mechanical Univ., College Station, Dept. of Genetics, Thesis (Ph.D.), Ann Arbor, Mich., Univ. Microfilms, Inc., Aug. 1967, 57p. 33 refs.

The effects of gaseous hydrogen fluoride on Drosophila melanogaster (flies) were investigated. The populations were exposed to different concentrations of HF for various treatment periods, and the effects on fecundity, hatchability, fertility, longevity, and generation time were studied. All of the parameters except generation time responded significantly to the HF treatment, with a range of responses from lethality to relatively no effect. The lethal concentration varied with strains but was very low for all the strains. In sublethal concentrations, the major treatment response was a function of treatment duration. Sublethal concentrations (less than 7.5% HF) caused measurable deleterious effects in the traits exhibited in the two strains, Oregon-r and yw, at the treatment levels and durations studied. (Author summary modified)

51953

Inst. for Policy Sciences (Japan)

PROGRESS TOWARD AN ECOLOGY SYSTEM DESIGNED TO HARMONIZE INDUSTRIAL ACTIVITIES AND NATURE. (Sangyo katsudo to shizen to no chowa no tame no ekoroji shisutemu e no sekkin). Text in Japanese. 509p., March 1972. 47 refs.

Sulfur dioxide emitted mostly from factories is believed to be responsible for most of the plant injuries. Although there are differences of the resistances toward this particular gas, most of the plants die in a few hours after being exposed to 0.4 to several ppm of sulfur dioxide. The injured plants generally show gray or brown spots on veins of leavs which eventually fall. The SO2, when washed by rain into soil, reacts with calcium and consumes the nutrients. Carbon monoxide and hydrocarbons of low molecular weight cause the destruction of chlorophyll and the abnormal falling of leaves. Other air pollutants that inhibit the growth and damage the plants include nitrogen oxides, smog, hydrogen fluoride, chlorine, hydrogen chloride, and airborne particulates.

52096

Tsunoda, Fumio and Hiroko Kunita

FLUORINE CONTENT OF PLANTS AND ANIMALS. (Doshokubutsu-chu no fusso ni tsuite - shizen to osen). Text in Japanese. Kogai to Taisaku (J. Pollution Control), 9(6):613-619, June 1973. 19 refs.

The fluoride content in the air can be measured by plant indicators, either by the extent of plant damage or by the cumulative fluoride content in the plant. The latter seems to be more effective when dealing with fluorine in the air, since a considerable amount of F accumulation in the plant sometimes does not manifest itself in damage. Leaves of gladioli are often used as indicators, but experiments have shown that the leaves of wild iris and flags are just as susceptible to F in the air. The pine and cedar needles and tulip and orange leaves are also sensitive indicators. The measurements of soluble fluorine in the air were taken for the past 5 years by the lime treated filter paper method and a dust meter in seven polluted areas, and the cumulative F content in the leaves of iris in these areas were compared with iris leaves in control areas. By the characteristic translocation of F, the tips and edges of leaves had much higher F content than other parts of the same plant. Approximately 1/3 of the measurements in those parts could be considered as a pollution index. The leaves taken from the most polluted areas showed approximately 80 times over the leaves from control areas in dry weight. Even 1/3 of the actual measurements was 100 ppm in dry weight, 30 ppm in raw weight. The produce in air polluted area has 5-10 ppm F content in polished rice and green vegetables. If the daily consumption of rice is 308 g/capita, 3.08 mg of F is taken daily into the human body.

52102

Maeno, Michio

AIR POLLUTION AND PLANT COMMUNITY. (Taiki osen to shokubutsu gunraku). Text in Japanese. In: Data on Pollution, No. 34: Environmental Protection Bureau, Yokohama City--Special Series City Environment and Biological Index. Yokohama Municipal Office (Japan), Environmental Protection Bureau, p. 21-28, April 1972.

The threshold of plant damages by pollutants such as ozone, peroxyacetyl nitrate, nitrogen dioxide, sulfur dioxide, hydrogen fluoride, chlorine, and ethylene, the general damage symptoms, the location of damages on plants, and vulnerable parts in plant structure are discussed and presented in a table. The external appearance of plant damage can be used as an index for air pollution. With some fluctuation by tree types, trees such as zelkova, gingko, and plane follow certain curves formed by damage indexes and the distances from the industrial areas. Also, the relationship between sulfur oxide concentration in the air and the sulfur trioxide content in the leaves of gingko forms a linear graphic relationship. The effect of SO2 on the general deterioration of trees and the sulfur content of tree leaves seem to have a certain relationship. Most of SO2 gas absorbed through the leaves into plants is accumulated as inorganic sulfuric acid ion, and very small amount changes into organic sulfur. The degree of sulfur degradation in plants are clearly different by the geographical locations of the plants, and in heavily polluted areas, the sulfur content in gingko leaves increase as time passes and reaches as high as 1.4% before the leaves drop. The portion that increases is soluble sulfur, and insoluble organic sulfur seems to remain at the same level. There is not much geographical difference in the amount of organic sulfur. Therefore, as an air pollution indicator, soluble sulfur, or the ratio of soluble sulfur to the total sulfur content in the tree should be considered.

52135

Fujiwara, Takashi

DAMAGE TO PLANTS BY COMPLEX POLLUTION OF THE ATMOSPHERE. (Taiki no fukugo oxen ni yoru shokubutsu no higai). Text in Japanese. Shokubutsu Boeki (Plant Prot.), 27(6):233-236, June 1973. 19 refs.

Plant damage caused by secondary pollutants such as peroxyacetyl nitrate or ozone are discussed. Several pollutants can cause a different effect on plants than an individual pollutant acting alone, these include sulfur dioxide plus ozone, SO2 plus nitrogen dioxide, NO2 plus O3, SO2 and NO2 plus O3, PAN or SO2 plus fluorides, O3 plus fluorides, and hydrocarbons plus SO2, NO2, or O3. There are additive, more than additive, or less than additive effects of coexistance. The specific effects of the synergistic action of two or more pollutants include necrosis and discoloration. In the case of SO2 acting in conjunction with O3, the lowest concentrations causing damage are 0.12/0, 0.1/0.01, and 0.05/0.05 ppm/ppm on green peas; no damage appeared at 0.1/less than 0.2; slight damage occurred at 0.2/0.1-0.2 ppm/ppm; and the addition of more O3 gave no more damage. The effect of SO2 and O3 on radishes was additive or less than additive; the effect of SO2 and O3 on Satsuma oranges was additive.

52306

Moura, J. de, D. le Tourneau, and A. C. Wiese

THE RESPONSE OF POTATO (SOLANUM TUBEROSUM) TUBER PHOSPHOGLUCOMUTASE TO FLUORIDE. Biochem. Physiol. Pflanzen, 164(3):228-233, 1973. 12 refs.

Most research on the effects of fluoride ions in plants has been concerned with aerial parts. For observation of the response to underground tissues, potato tubers were fluoridated. At the same time in vitro studies on the effect of fluoride on phosphoglucomutase (PGM) from untreated tubers were made. Protein content was measured by Eaddell s method. Najjar s procedure was modified for enzyme activity tests. Phosphoglucomutase was partially purified from potato tubers and was relatively insensitive to the presence of fluoride ions in vitro. The enzyme was activated by magnesium(++) but not by manganese(++) ions, and was not inhibited by fluoride(-) in the presence of Mn(++). The enzyme was relatively insensitive to F(-) when Mg(++) was present, but the amount of inhibition was dependent on the level of Mg(++) and, more importantly, on the order of mixing the reagents prior to the assays. (Author abstract modified)

52397

Peterson, P. J.

UNUSUAL ACCUMULATIONS OF ELEMENTS BY PLANTS AND ANIMALS. Sci. Prog., Oxf., 59(236):505-526, Winter 1971. 79 refs.

The accumulation of certain elements to very high levels by plants and other organisms is outlined. In higher plants, the ability to accumulate elements and to survive on soils containing toxic quantities of various elements occurs sporadically throughout different species, but in lower plants a higher concentration of some elements is typical of a particular order. Elements accumulated by some higher plants include copper, strontium, calcium, zinc, rare earths (the hickory tree), aluminum, silicon, and nickel. Among lower plants, algae accumulate iodine and bromine dust; fungi, selenium and vanadium; mosses, copper, boron, and vanadium; lichens, ytrrium, gallium, tin, and lead; horsetails, silicon and zinc; lycopods, aluminum; and ferns, yttrium and uranium. Copper, cadmium, arsenic, barium, and fluoride are accumulated by certain marine organisms. Mammalian accumulator tissues exist for many elements including iodine, titanium, aluminum, vanadium, zirconium, and selenium. Some of the mechanisms which may enable an organism to survive an accumulated element are: the toxic element is excluded or partially excluded from the cells; the element is confined to the cell wall; the element enters the cell and is metabolized to possibly inactive components or by binding with another compound.

52409

Matsuchima, Jiro

MONITORING OF AIR POLLUTION USING PLANTS AS MONITORS. (Shokubutsu o shihyo to shita taiki osen no kanshi). Text in Japanese. Shokubutsu Boeki (Plant Prot.), 27(6):259-260, 1973.

Plants can be used to monitor air pollution by measuring the characteristic visible damage and its degree, the defoliation and discoloration, the retention of pollutants by the leaf, and the effects on reproduction. Indicator plants should be very susceptible to one specific pollutant or equally susceptible to every pollutant by showing specified symptoms. Such plants should also constantly develop new leaves and be resistant to diseases and insects. Alfalfa and buckwheat are used to monitor sulfur dioxide. Pinus densilflora is susceptble to SO2. Gladioli and turnips are susceptible to hydrogen fluoride. Apricot, plum, and grape are weak indicators of HF. Tobacco and morning glory can be used to measure ozone. Petunia shows specific damage due to peroxyacetyl nitrate. Buckwheat and tomatoes react to ethylene and propylene as if they were exposed to growth homones at levels of 0.05 and 0.1 ppm, respectively. Measuring pollutant concentrations in leaves is used to measure chronic effects of low concentrations of pollutants, such as HF in citrus leaves. Sulfur is naturally contained in normal plants and the content varies with the season, however, S content in citrus leaves is unusually high when the plants are grown in a SO2-rich atmosphere.

52574

Bohne, H.

FLUORIDES AND SULFUR DIOXIDES AS CAUSES OF PLANT DAMAGE. Fluoride, 3(3):137-142, July 1970. 8 refs.

Fluoride and sulfur trioxide levels were determined in three polluted industrial areas where the two pollutants had damaged vegetation. The appearance of the leaves was typical of fluoride injury with no indication of toxicity by sulfur dioxide. Chemical analyses of fluoride and SOx contents of the injured plants supported these findings. Fluoride levels in gladioli ranged within 3.4-8.7 mg% whereas SO3 levels ranged within 0.77-1.15%, thus showing that the greatest damage from combustion products was caused by fluoride compounds, primarily hydrogen fluoride. (Author summary modified)

52651

Wheeler, Garland Laurin

THE EFFECTS OF FLUORINE ON THE CYCLING OF CALCIUM, MAGNESIUM, AND POTASSIUM IN PINE PLANTATIONS OF EASTERN NORTH CAROLINA. North Carolina State Univ., Raleigh, Dept. of Botany, Thesis (Ph.D.), Ann Arbor, Mich., Univ. Microfilms, Inc., 1972, 72p. 66 refs.

The effect of fluorine emissions from ore processing plants in pine ecosystems, with respect to the points of accumulation and the effects on the cycling rates of calcium, magnesium, and potassium, was investigated in North Carolina pine plantations. The only visible damage occurred during the late winter and early spring and was characterized by a visible browning or necrosis of needles. Fluorine was associated with an increase in the return rate of Ca and K through leaf leaching and of all three nutrients, Ca, K, and Mg, by increasing the amount of litterfall. The Ca content of the litterfall increased with increasing F content. There was no detectable relationship between F or the three nutrients and net primary production. The sites of accumulation of F were in the needles, litter, and soil. The trees accumulated the greatest amount of Ca, followed by K and Mg in that order. (Author summary modified)

52698

Fujii, Shintaro

THE STATUS QUO OF PLANT DAMAGE BY AIR POLLUTION IN OKAYAMA PREFECTURE. (Okayama-ken ni okeru taiki osen ni yoru shokubutsu higai no genjo). Text in Japanese. Shokubutsu Boeki (Plant Prot.), 27(6):249-252, 1973.

Plant damage in Okayama Prefecture includes grape damage caused by fluorine from a firebrick manufacturing factory and vegetable and fruit tree damage due to oxidants such as ozone. By regulating hydrogen fluoride concentrations to less than 5 ppb/hr, grape damage was eliminated. Ozone damage (withering) has occurred on taro, Japanese leek, and Japanese radish. Experimental exposure of plants to 0.4-0.5 ppm for 1.5-6.0 hr, 0.25-0.3 ppm for 4-7 hr, and 0.25 ppm of O3 plus 0.1 ppm of sulfur dioxide for 2-2.5 hr caused deep green spots on taro, which developed into white or grey spots on the leaves. Japanese leeks had whitening of leaf tops when exposed to 0.5 ppm of O3 for 2 hr, 0.25-0.3 ppm for 5-6 hr, 0.1 ppm for 14 hr, and 0.25 ppm of O3 plus 0.1 ppm of SO2 for 4.5 hr. Recently other plants have suffered damage such as insufficient growth, lack of fruit, defoliation, and dropping of fruit, which suggest damage due to ethylene. Sulfur dioxide is suspected of causing tip-withering of mat grass in the southern part of Okayama Prefecture.

52705

Robak, Hakon

PROBLEMS AND TASKS OF DIAGNOSIS OF FOREST INJURIES CAUSED BY AIR POLLUTION. (Probleme und Aufgaben der Diagnostik der durch Luftverunreinigung verursachten Waldschaeden). Text in German. Preprint, International Union Forest Research Organization, 10p., 1972. (Presented at the International Union Forest Research Organization Congress, Sopron, Hungary, Oct. 9-14, 1972.)

The tasks of diagnosing injuries from air pollution involve the determination of whether the observed injury does indeed stem from air pollution and which emission component caused the injury. The problems of diagnosis are manifold due to the different reactions of the plants to the various pollutants or to the absence of reactions. A brief review of direct and indirect effects of air pollutants is given. In cases of very mixed pollu-

tion coming from many different sources, the decisive factors can be determined only through greenhouse exposure experiments. Leaf and needle analyses are valuable tools for diagnosis. Anatomic criteria, growth retardation, and harvest losses are not specific enough. Aerial photography also lacks specificity. Doubts still exist concerning the specific sensitivity of indicator plants. Some experts place the Medicago sativa plant among the sulfur dioxide indicator plants claiming that this plant is rather resistant to fluorine, while others group it with the fluorine indicator plants on the grounds that this plant reacts to very small concentrations of fluorine with minor but visible injuries. Widespread agreement seems to exist that lilies are particularly sensitive for fluorine, papilionacae for SO2. Lichens and mosses are obviously indicators of the general air pollution. The problem of injuries by indirect emissions which may spread over thousands of kilometers is discussed. For instance, sulfuric acid formed through oxidation of SO2 and subsequent water intake renders strongly acid precipitation which particularly affects soils with a weak buffering capacity, and eventually all vegetation growing in such soils.

52829

Carlson, C. E.

FLUORIDE POLLUTION IN MONTANA. Fluoride, 6(3):127-137, July 1973. 6 refs.

An intensive study of the effect of airborne fluorides on vegetation was undertaken in 1970 in the vicinity of an aluminum production plant in northwestern Montana. Fluorides greater than control levels (10 ppm) were found in vegetation over a region of 214,000 acres, and visual fluoride injury to conifers occurred in an area comprising 69,000 acres. Histological reactions characteristic of elevated fluoride levels occurred in conifer needle tissue, including hypertrophy of parenchymatous tissue. Forest insects were found to accumulate fluorides. Analyses of predaceous insects for fluoride indicated that fluorides are likely to be carried through the food chain. Even though the company reduced fluoride emissions by 67% between 1970 and 1971, data collected in 1971 indicated that vegetation in Glacier National Park, 7 air miles distant from the source, was still accumulating abnormal amounts of fluoride. (Author abstract)

52928

Yamazoe, Fumio

THE AIR-POLLUTANTS WHICH CAUSE PLANT DAMAGE. (Shokubutsu higai no genin to naru taiki osen busshitsu). Text in Japanese. Shokubutsu Boeki (Plant Prot.), 27(6):220-223, June 1973. 5 refs.

Ozone and peroxyacetyl nitrate and its homologues cause oxidative damage to plants. Sulfur dioxide, formaldehyde, hydrogen sulfide, and carbon monoxide cause reductive damage. Hydrogen fluoride, silicon tetrafluoride, hydrogen chloride, sulfur trioxide, sulfuric acid mist, and hydrocyanic acid cause acidic attacks. Ammonia causes alkaline attacks. Ethylene, propylene, soots, smokes, dusts, metal, metals oxides, and other particulates also cause plant damage. Pollutants are classified according to order of toxicity as follows: strongly toxic substances causing symptoms as the ppb level such as fluorine, chlorine, and PAN; moderately toxic substances causing symptoms at ppm levels such as sulfur oxides and nitrogen oxides; and fairly toxic substances which cause symptoms at levels between tens and thousands of ppm such as aldehydes, HCl, NH3, HCN, H2S, and CO. Recently, damgae due to the synergistic action of two pollutants has been increasing (such as SO2-HF, SO2-PAN, and SO2-O3). Origin, toxicity, and damage mechanism of major pollutants are discussed.

52964

Gruender, H.-D.

STUDIES ON THE EFFECT OF FLUORINE EMISSION ON CATTLE. (Untersuchungen ueber die Fluorimmissionswirkungen auf Rinder). Text in German. Deut. Tieraerztl. Wochschr., 79(7):147-150, 1972. 3 refs.

Studies on the effects of fluorine emissions on cattle in the nearby of industrial plants emitting fluorine compounds are reviewed. Dental fluorosis, bone fluorosis with such manifestations of exostosis or hyperostosis, reduction of the elasticity of the bones with increased susceptibility to fracture, and reduction of the food uptake are among the principal consequences of daily fluorine intakes exceeding the normal value by 5 to 10 times. The effect of administering aluminum salt mixtures with the feed or drinking water to lower fluoride resorption was studied. Damage due to fluorine in cattle can be reduced by special management and feeding techniques.

52994

Carlson, Clinton E.

MONITORING FLUORIDE POLLUTION IN FLATHEAD NATIONAL FOREST AND CLACIER NATIONAL PARK. Forest Service, Missoula, Mont., Forest Insect and Disease Branch, 27p., 1971 (?). 4 refs. (The same information described in this paper also appears in Carlson, Clinton E. and Jerald E. Dewey, Environmental Pollution By Fluorides, Forest Service, Missoula, Mont., Forest Insect and Disease Branch 62p., Oct. 1971. 27 refs.)

Measurements of fluoride pollution made in 1971 in Flathead National Forest and Glacier National Park, caused by fluoride emissions from the Anaconda Aluminum Company at Columbia Falls, Montana, are presented and compared with a similar study completed in 1970. Chemical analysis of vegetation indicated average fluoride concentration from 4% less, in Glacier National Park, to 77% less, close to the aluminum plant, when compared to 1970 data. Injury indexes dropped an average 45.8%. The total polluted area was 59 sq mi (34,560 acres) less than in 1970, and injury was found on 84 sq mi (53,920 acres) less than in 1970. Analysis of insect tissue indicated insects are still accumulating excessive fluorides. Above-normal fluorides are still accumulating in vegetation up to 12 miles from the Glacier National Park.

53025

Dewey, Jerald E.

ACCUMULATION OF FLUORIDES BY INSECTS NEAR AN EMISSION SOURCE IN WESTERN MONTANA. Environ. Entomol., 2(2):179-182, April 1973. 12 refs.

Four major groups of insects such as pollinators, predators, foliage feeders, and cambial region feeders were collected near an aluminum reduction plant and analyzed for fluorides. Collections were made in June, August, and October in 1970 and in August 1971. From 58.0 to 585.0 ppm fluoride was found among the pollinators, from 6.1 to 170.0 ppm among the predators, from 21.3 to 255 ppm among the foliage feeders, and from 8.5 to 52.5 ppm among the cambial region feeders. Fluoride levels among the control insects sampled ranged from 3.5 to 16.5 ppm. The relative high fluoride levels in the 100% predatory insects indicate fluorides are either accumulated by respiration or are passed along the food chain. (Author abstract)

53370

Wander, I. W. and J. J. McBride, Jr.

CHLOROSIS PRODUCED BY FLUORINE ON CITRUS IN FLORIDA. Science, vol. 123:933-934, May 25, 1956. 6 refs.

A unique chlorotic leaf pattern on citrus trees in Florida that is attributed to florine is reported. The chlorosis was first noted in Polk County in April 1950 and was associated with a triple superphosphate manufacturing plant that recently opened. The polluting condition was corrected, but as new triple superphosphate plants opened, chlorosis increased. Florida pebble rock phosphate contains 2-4% fluorine which is released during the production in triple superphosphate. Chlorotic leaves from affected groves ranged in fluorine content from 370 ppm to as low as 48 ppm. Chlorotic citrus leaves were observed uo to 6 miles away from the nearest plant, but the leaves were not abnormally high in fluorine content. It appears that fluorine causes leaf chlorosis and is then dissipated by translocation. Normal appearing leaves away from the affected area contained from 12 to 30 ppm fluorine. In 1955 sprays of aqueous acids were applied at concentrations 0.1N to 4 year old Ruby Red grapefruit trees located 20 miles from the nearest triple superphosphate plant. Seven sprays of 1 l of solution each were applied during a 2-month period, and an identical chlorotic leaf pattern emerged in the trees sprayed with hydrofluoric and fluosilicic acid. Citrus trees in California that contained up to 211 ppm fluorine did not develop chlorosis and may be the results of differences in climatic conditions, primarily the higher humidity in Florida.

53376

Trautwein, K., Chl. Kopp, and R. Buchner

FLUOROSIS AND ENVIRONMENTAL HYGIENE. (Fluorose und Umwelthygiene). Text in German. Tieraerztl. Umsch., 27(1):7-8, 10-12, 14-16, 1972. 54 refs.

A review of fluorosis in animals, as reported in veterinary medical journals, is presented. Although ubiquitous in nature in micro-quantities, fluorine is present in considerable amounts in the vicinity of aluminum foundries and other industrial plants which are responsible for its emission. The fluorine is taken up by plants and transmitted to animals in their fodder or in their drinking water. It has been established (in Germany) that the ingestion by animals of more than 1.0 mg of fluoride/kg body weight/day could result in fluorosis, with more than 1.5 mg, fluorosis is sure to occur. In chronic fluorine poisoning the most marked clinical symptoms are changes in the teeth and bones and characteristic lameness. The chronic absorption of slight quantities of hydrofluoric acid from the air constitutes the greatest threat to plants; the danger of fluoride uptake through plant roots from the soil is less likely. The effect of the poison in all organisms is enhanced by external factors such as humidity and temperature of the air. With more effective supervision to avoid the introduction of fluorine into plants and into the air, and with proper supervision of animal fodder, it is possible to prevent toxic effects.

53903

Japan Society of Air Pollution, Research Committee

PHOTOGRAPHS OF PLANTS DAMAGED BY AIR POLLUTION. (Taiki osen shokubutsu higai shashin-shu). Text in Japanese. 229p., March 1973. 17 refs.

Plant damage by air pollutants are displayed in hundreds of photographs. Pollutants such as sulfur dioxide, nitrogen dioxide, and ozone cause necrosis between veins of leaves, hydrogen fluoride causes necrosis at the edges of leaves. Oxidants such as aldehydes and peroxyacetyl nitrate (PAN) cause the formation of silver-grey color on the backs of leaves. At lower pollutant concentrations, chlorosis of leaves or invisible injuries such as plant growth retardation occurs. Plants weak in resistance to SO2 are alfalfa, barley, cotton, marvel-of-Peru, rhubarb, cosmos, and sweet pea; those strong in resistance are musk melon, citrus fruits, celery, and chrysanthemum. The resistance to SO2 increases as the humidity decreases. The threshold value of HF was several ppb using gladiolus as the indicator plant. The resistances of plants to air pollutants depend not only on the plant and pollutant, but also on meteorological conditions and planting conditions.

54066

Sekiuchi, Teruo, Kaku Kikuchi, and Hikaru Sone

QUICK QUANTITATION OF FLUORINE IN PLANTS, REPORT 1. (Shokubutsu- taichu fusso no jinsoku teiryo ni tsuite (dailppo)). Text in Japanese. Miyagi-ken Kogai Gijutsu Senta Hokoku (Miyagi Prefect. Pollut. Contr. Tech. Center Rep.), no. 1:36-40, May 1973. 4 refs.

In the Ishimaki area where a phosphate fertilizer manufacturing plant has damaged the grape and pear harvest by its fluoride emission in 1970, measurement of fluoride in the leaves is one method of assessing the plant damage. Presently, the Association of Official Agricultural Chemists (AOAC) method is generally in use, but it is complicated and time consuming. A simplified wet combustion or dry combustion-steam distillation method was examined in the lab, and the results were reported. The preparation of reagent (60% perchloric acid, acetone, silver perchlorate), preparation of samplings, wet combustion, dry combustion, distillation, and photoelectric colorimetry application are described. The fluoride loss during the distillation process was negligible. The fluoride loss during reflux was within 10%. The fluoride recovery rate was best during the third hour of reflux; therefore all the measurements were taken in the third hour. The recovery rates by the AOAC method ranged between 86.5% and 94.5%; the proposed method ranged 88.1% and 93.8%. The measurements of the both methods agreed very well. But the proposed method has the following advantages: it is simple and there is no F loss in the process; the time for analysis is shortened by half; the time and trouble for the preparation of milk of lime is eliminated and pollution by the muffle furnace is eliminated. The proposed method may present a problem with samples containing small amount of F, but it is considered appropriated for F quantitation of damaged plants.

54297

Knabe, W.

POLLUTION AND ITS THREAT TO FORESTS IN THE RUHR. (Immissionsbelastung und immissionsgefaehrdung der Waelder im ruhrgebiet). Mitt. Forst. Bundesuers., no. 97/1:53-87, 1972. 30 refs. Translated from German, 36p. (Presented at the International Symposium of Forest Fume Damage Experts, 7th, Essen, West Germany, Sept. 1970.)

The effects of air pollution on the forests in the industrial areas of the Ruhr district are discussed. No older spruce and pine stands of yield classes I-V are found in the center of the Ruhr district. The remaining stands are characterized by a lower needle age, sparse crowns, reduced growth in height and diameter, as well as increased amounts of dead wood resulting from the additional action of secondary parasites. Concentrations of sulfur, fluoride, chloride, and lead are found in needles and leaves. Acute damage to broadleaved species is concentrated in the vicinity of certain industrial plants which emit fluorine and chlorine compounds. The causes of chronic pollu-

tion damage are primarily sulfur dioxide, halogen compounds, oxidizing agents, and dusts. The extent to which heavy metals are causes for damage has not been determined. The danger of pollution to conifers is estimated in North Rhine-Westphalia in part of the basis of the SO2 measuring program, with SO2 being considered to be both a harmful substance and an indicator for general air pollution. The risks of cultivating conifers is estimated in part according to the frequency with which certain mean values for the growth season are exceeded. In the central area, the growth season mean value of 0.08 mg SO2/cu m was as a rule exceeded in at least 3 of 4 years, in the border area it was reached or exceeded as a rule at least in 1 year. (Author summary modified)

54597

Yamatomo, Takeo

POLLUTION AND ITS CIRCUMFERENCE (IV): BIOLOGICAL USE AND ENVIRONMENTAL INVESTIGATION. (Kogai to sono shugen 4, Seibutsu riyo to kankyo chosa). Text in Japanese. Kagaku to Yakugaku no Kyoshitsu (Chem. Pharm., Quart. J.), no. 40:6-11, 1973. 5 refs.

For measurement of traceable sulfur oxide, the use of microbiological quantitation of sulfate ions is reliable and convenient for treating a large amount of test material simultaneously. This method is also useful for examining bacterial proliferation inhibitors or inhibiting factors. Quantitation of sulfates in rain water by the colitis bacteria (Escherichia coli), and the relationship between inhibitors and toxic metals are discussed. The pattern of hydrogen fluoride damages was examined by gladioli and orange leaf experiments. The SOx first damages the plant s spongy parenchyma and then the total system. The damages appear first in spots, and then turn into gray, white or yellow as the symptom advances. The HF can be absorbed in gas form through the stomata of the epidermis and damage spongy parenchyma and palisade, or water soluble compounds in HF can be absorbed into plant. Once absorbed, HF moves to the tips or edges of the leaves, and the accumulation causes graying or browning of the leaves. Traceable amounts of HF can damage agricultural produce visibly. In the area 1-2 km from the emission source, plants can have approximately 150 ppm, or five times the HF accumulation in a control area. Rats were raised at a street intersection to see the effects of automotive exhaust gas. An interesting and significant inhibition of weight increase was noted among one group of rats. The lead content in the atmosphere or the dust count did not show a significant difference from other exposure areas. In addition to exhaust gases, noise, light, and other conditions such as ventilation, temperature, and vibration seemed to have inhibited the growth of the rats.

54710

Weinstein, Leonard H., Jay S. Jacobson, and Richard H. Mandl

FLUORINE--SEMIAUTOMATED METHOD. J. Assoc. Offic. Anal. Chemists, 55(5):998-1003, Sept. 1972.

A semiautomated, colorimetric method for the analysis of fluoride in vegetation is presented. Dried and ground plant material is ashed, fused with alkali, and diluted to volume. Leaf samples may be washed with an aqueous solution containing 0.05% detergent and 0.05% tetrasodium ethylene diamine tetracetic acid salt. The digest and sulfuric acid are then pumped into microdistillation apparatus which is maintained at 170 C. A stream of air carries the acidified sample to a fractionation column where F and water are distilled into a condenser; the condensate passes into a small collector. The distillate is mixed continuously with alizarin F blue-lanthanum reagent, the colored stream passed through a tubular flowcell of the colorimeter, and the absorbance measured at 624 nm. Conditions must be carefully controlled since accurate results depend upon obtaining the same degree of efficiency of distillation from samples as from standard F solutions used in calibration. The temperature must be maintained within plus or minus 2 C, and regulation of the acid concentration during distillation is achieved by taking plant samples in the 0.1-2.0 g range and by using specified amounts of calcium oxide and sodium hydroxide for ashing and fusion. Interfering metal cations and inorganic phosphate are not distilled, and organic substances are destroyed by ashing. Interference from remaining volatile inorganic anions is reduced with high concentrations of acetate buffer at the expense of some reduction in sensitivity. The method can detect 0.1 micrograms F/ml, and the normal range is 0.1-4.0 micrograms F/ml.

54755

Houten, J. G. ten

BIOLOGICAL ASPECTS OF AIR POLLUTION. (Biologische aspecten van de luchtverontreiniging). Text in Dutch. Chem. Weekblad, 69(26):11-12, June 1973. 11 refs.

Studies on the effects of air pollutants, such as automotive exhaust components, sulfur dioxide, hydrofluoric acid, and ozone, on plants, animals, and humans are reviewed. Very high susceptibility of spinach and lettuce to ozone and peroxyacetyl nitrate was observed. Nitrogen oxides cause leaf burns in certain plants, while nitrogen dioxide interferes with growth processes in tomatoes in concentrations as low as 0.25 ppm. Ethylene in above-normal concentrations has similar effect on tomatoes. Necrosis of leaf tissues due to the action of SO2 was observed. The acidification of the soil and of surface water bodies, a process most acute in Sweden due to SO2, interferes with the lives of certain plant and animal species. Lichens were determined to be most sensitive to SO2 of all plants. Leaf burns and inhibition of the cis-aconitase in Fresia and Gladiolus species due to hydrofluoric acid was evidenced. This pollutant also tends to reduce bee populations in polluted areas.

54910

Matsushima, Jiro and R. F. Brewer

INFLUENCE OF SULFUR DIOXIDE AND HYDROGEN FLUORIDE AS A MIX OR RECIPROCAL EXPOSURE ON CITRUS GROWTH AND DEVELOPMENT. J. Air Pollution Control Assoc., 22(9):710-713, Sept. 1972. 13 refs.

The influence of exposure to mixtures of sulfur dioxide and hydrogen fluoride on Koethen sweet orange, and alternate exposure to these gases on Satsuma mandarin, were tested using a rotating fumigation greenhouse. The concentration of SO2 was effectively maintained at approximately 0.8 ppm or 2.3 mg/cu m during the experiment, but the HF concentration varied from approximately 2.5 ppb or 2.2 micrograms/cu m at the beginning of the experiment to approximately 13 ppb (11.6 micrograms/cu m) at the end. Effects of HF-SO2 mixtures on linear growth and leaf area of Koethan orange were additive, not synergistic. No necrosis was observed on Koethen oranges exposed to HF, SO2, or a mixture of HF and SO2. Effects of the mixture on chlorosis of Satsuma mandarin foliage was also not synergistic. No significant difference in linear growth of Satsuma mandarin was found. Alternate exposure to SO2 followed by HF produced no synergistic injury to Satsuma mandarin. Satsuma mandarin appeared more sensitive than Koethen orange to HF, SO2, and mixtures of these two gases, using degree of chlorosis and leaf abscission as the criteria of sensitivity. If linear growth and leaf area were the principal

criteria considered, Koethen orange would appear more sensitive. (Author abstract modified)

55066

Nasr, T. A. and M. G. Hassouna

TOLERANCE OF BANANAS TO FLUORIDES AND SULPHUR DIOXIDE. Alex J. Agr. Res., 18(1):115-118, 1970. 8 refs.

The sensitivity of banana plants growing near the superphosphate plant at Kafr-El-Zayat, U.A.R. to fluorides and sulfur dioxide was investigated. The growth of the fourth ratoon plants raised in this area was compared with that of plants raised in a non-industrial area (Alexandria). The results indicated that the plants from the two areas were similar in terms of height of the pseudostem, length of the bunches, average number of hands per bunch, number of fingers per hand, and average number of fingers per hand per bunch. The plants in Kafr-El-Zayat showed no visual symptoms of foliage lesions, severe chlorosis, or necrosis. Although the margins of the lamina were dry and scorched, the same observation was made of the plants in Alexandria. The air pollutants in the area at Kafr-El-Zayat are present in concentrations not injurious to banana plants grown in the area.

55654

Keller, Theodor

THE PHYTOTOXICITY OF PARTICULATE FLUORINE COMPOUNDS. (Zur Phytotoxizitaet staubfoermiger Fluor-Verbindungen). Text in German. Staub, Reinhaltung Luft, 33(10):395-397, Oct. 1973. 8 refs.

The toxicity of particulate fluorides was tested on 3-year old pot-bound pines (pinus silvestris), on 4-year old douglas firs (psuedotsuga menziesii), and on 1-year old birches (betula verrucosa). The first series of experiments was used for determination of the toxicity of more or less water insoluble fluorine compounds at high humidity. Thye pines were therefore exposed in two different greenhouses. One was normally ventilated, the other had a relative humidity of 75% and more at all times. With the second test series the plants were exposed under outdoor conditions. The effect of the dusts on photosynthesis was statistically not significant in the absence of visible injury. This may be due to the anatomical feature of conifer needles and may be valid for particulate fluoride only.

56204

Bennett, Jesse H. and A. Clyde Hill

INHIBITION OF APPARENT PHOTOSYNTHESIS BY AIR POLLUTANTS. J. Environ. Qual., 2(4):526-530, Oct.-Dec. 1973. 35 refs.

The reversible effects of hydrogen fluoride, sulfur dioxide, and chlorine exposures on net carbon dioxide absorption rates (apparent photosynthesis) of alfalfa and barley plants were investigated. Carbon dioxide uptake was reversible suppressed by exposure dosages of these pollutants which did not cause cellular destruction in the leaves. Some necrosis resulted, except for the nitrogen oxides, from treatments which depressed CO2 uptake rates more than 25-60% by the end of 2-hour fumigation trials. The six air pollutants can be ranked in the following descending order according to the relative amounts that plant CO2 uptake rates were depressed by the end of 2-hour exposure: HF, ozone, Cl2, SO2, nitrogen dioxide, nitric oxide. The phytotoxicants ranked in essentially the reverse order when compared on the basis of the rapidity that CO2 uptake was suppressed as a function of exposure time. Nitric oxide treatments caused very rapid reductions in the plant CO2 uptake rates during the first hour of exposure. By this time, plant uptake rates had attained new (depressed) steady state equilibrium levels which were then maintained over the remainder of the exposure periods. Hydrogen fluoride treatment induced more gradual reductions in plant CO2 uptake rates throughout the test periods. Plant responses to the other pollutants, SO2, NO2, Cl2, and O3 were intermediate between those caused by NO and HF. (Author abstract modified)

56213

Miller, G. W., M. H. Yu, and M. Psenak

PRESENCE OF FLUORORGANIC COMPOUNDS IN HIGHER PLANTS. Fluoride, 6(3):203-215, Oct. 1973. 20 refs. (Presented at the International Society of Fluorine Research, Annual Conference, 5th, Oxford, England, April 4-8, 1973.)

A number of exotic plants are known to contain fluoroorganic compounds. The toxic component of more than a dozen plant species of fluoroacetate. Indirect evidence using extraction with nonpolar solvents combined with paper chromatography, inhibition of aconitase, and infrared spectrometry indicated the presence of fluoroacetate and fluorocitrate in soybean and crested wheat grass exposed to atmospheric fluoride. Gas chromatographic analysis of organic acids isolated from crested wheat grass collected from areas of high atmospheric fluoride pollution showed the presence of two peaks that corresponded with the methyl esters of authentic fluoroacetate and fluorocitrate. The organic acid pattern in the fluoride-exposed plants was also significantly changed compared to control tissue. (Author summary)

56240

MacLean, David C., Robert E. Schneider, and Delbert C. McCune

FLUORIDE PHTOTOXICITY AS AFFECTED BY RELATIVE HUMIDITY. Proc. Int. Clean Air Congr., 3rd, Duesseldorf, West Germany, 1973, p. A143-A145. 16 refs.

The effects of relative humidities on hydrogen fluoride-induced leaf necrosis and accumulation of fluoride in gladiolus plants are presented. Plants were exposed to 4.5 micrograms F/cu m for 144 hr after acclimation to relative humidities of 50, 65, and 80% relative humidities and were then maintained in the chambers under the same environmental conditions for 24 hr to allow symptoms to develop. Relative humidity did not affect the incidence of injury; the percentage of leaves per plant showing some degree of necrosis was not statistically different at the three relative humidities. The physiological age of the leaves did, however, influence the incidence of necrosis. Relative humidity of the air surrounding the plants during exposure to hydrogen fluoride did affect the severity of HF-induced injury (percentage of leaf length necrotic); necrosis was more severe on plants exposed at 80% relative humidity than that at 65 or 50%. The amount of accumulated F localized in the medial and basal portions of leaves was negligible and was not affected by relative humidity.

56241

McCune, Delbert C., Leonard H. Weinstein, Jill F. Mancini, and Paul van Leuken

EFFECTS OF HYDROGEN FLUORIDE ON PLANT-PATHOGEN INTERACTIONS. Proc. Int. Clean Air Congr., 3rd, Duesseldorf, West Germany, 1973, p. A146-A149. 32 refs.

Experiments in fumigation chambers with tomato and pinto bean plants were performed to assess the effects of hydrogen fluoride on plant-pathogen (fungal and bacterial) interactions. Hydrogen fluoride was found to alter the plant-pathogen in-

teraction, although the kind and consistency of effect caused by HF depended upon the host, pathogen, and several other factors. A reduction in powdery mildew probably indicates that HF was affecting the infectivity of the pathogen itself because reduction in disease was proportional to the length of the exposure period, infection was continuous during the exposure period, and the pathogen itself was epiphytic. The effect of fluoride on bean rust may have been due to accumulated fluoride in the leaf having a direct or indirect effect on the pathogen because both pre- and post- inoculation exposures to HF were effective and additive. Other evidence for an indirect effect of fluoride was found in halo-blight where stem collapse was affected but foliar symptoms were not, and the site affected was spatially removed from the site of fluoride accumulation. Effects on early blight of tomato also indicated an effect of fluoride in the leaf.

56428

Dept. of Trade and Industry, Great Britain, Programmes Analysis Unit

SECTION IV(F): THE DAMAGE TO AGRICULTURE. In: An economic and technical appraisal of air pollution in the United Kingdom. London, H. M. Stationery Office, 1972, p. 140-149. 4 refs.

The effect of air pollution on agricultural plants and animals in Great Britain is described. Sulfur dioxide can affect life in three ways: as a constituent of the air, as rain, or as acidic mist. Depending on its form, SO2 can affect the soil and the health of the plants, cause delayed blooming, premature senescence, and leaf damage. Smoke reduces the supply of light radiation for photosynthesis and may block the stomatal pores. Fluorine, besides retarding growth in plants as a result of destruction of tissue, can damage animal bone and teeth. Oxides of nitrogen are emitted in relatively small quantities compared to SO2. The oxidizing action of nitrogen dioxide or nitric acid washed out by rain could produce direct damage to foliage. Other pollutants which adversely affect vegetation include lead, ethylene, ozone, and organic sulfur compounds. A discussion on the cost of damage by air pollution to agriculture in Great Britain is included.

56515

MacLean, D. C. and R. E. Schneider

FLUORIDE ACCUMULATION BY FORAGE: CONTINUOUS VS. INTERMITTENT EXPOSURES TO HYDROGEN FLUORIDE. J. Environ. Quality, 2(4):501-503, Oct.-Dec. 1973. 9 refs.

The effect of continuous versus intermittent exposures to hydrogen fluoride was investigated with timothy (Phleum pratense L.,) and red clover (Trifolium pratense L.) plants. Fluoride accumulation was greater after continuous fumigations than when the same HF dose was provided in alternate 48 hr exposures. The importance of the intermittent nature of exposures in addition to the pollutant concentration and duration of exposure in governing F accumulation suggests that pollution abatement action to protect livestock from ingested F should be based on the F content of forage rather than the concentration of airborne fluorides. (Author abstract modified)

56521

Weinstein, Leonard H., Delbert C. McCune, Jill F. Mancini, and Paul van Leuken

EFFECTS OF HYDROGEN FLUORIDE FUMIGATION OF BEAN PLANTS ON THE GROWTH, DEVELOPMENT, AND REPRODUCTION OF THE MEXICAN BEAN BEETLE. Proc. Int. Clean Air Congr., 3rd, Duesseldorf, West Germany, 1973, p. A150-A153. 16 refs.

The growth and behavior of Mexican bean beetle populations on control and hydrogen fluoride-fumigated bean plants (P. vulgaris L. ev. predominantly) were investigated to assess the effects of such fumigation on beetle growth, development and reproduction. Beetles that were cultured on HF-fumigated plants were generally lighter than controls, although the occurrence and magnitude of this effect depended upon stage of development, age, and sex of the adult beetle and the number of generations of culture on HF-fumigated plants. A consistently decreased mass of larvae cultured on HF-fumigated plants reflected a delay in development as well as a reduced growth. Larvae from the eggs laid by beetles cultured on HF-fumigated tissue pupated and eclosed three to six days later than controls, and the adults commenced reproductive activity with the same lag in time. Beetles cultured on the fumigated plants also contained greater amounts of fluoride than the controls, and the fluoride content of females was greater than that of males on both HF-fumigated and control plants. Beetles raised on fumigated plants laid fewer egg masses and fewer eggs per mass, although when the first generation was repeated at a later date there was no significant effect. Feeding activity was reduced in both larval and adult stages in beetles cultured on the fumigated plants, and adults showed less flight activity than controls. A difference in color of the elytra was also noted; beetles on HF-fumigated plants were paler than controls.

56584

Berge, Helmut

RELATIONSHIP BETWEEN TREE PESTS AND IMMISSIONS. (Beziehungen zwischen Baumschaedlingen und Immissionen). Text in German. Anz. Schaedlingskunde, vol. 46:155-156, 1973. 2 refs.

In a forest in the vicinity of a large sulfur dioxide emission source, lice were discovered on the species abies concolor and abies veitchi mainly on those needles where injuries from SO2 and hydrogen fluoride exposure were macroscopically and microscopically visible. All abies species whose new shoots were treated with a pesticide until the second half of May showed no injuries on the new 1-year old needles. Non-treated trees showed either injuries or dropped the needles. Contrary to this, mealy bugs on pinus griffithi, pinus silvestris fastigiata and pinus silvestris pumily were mostly found on the non-injured needles and not on those showing macroscopic and microscopic SO2 injuries. Species of Ilex aquifolium uninjured by SO2 suddenly displayed acute injuries after they had been heavily attacked by the fly phytomyza ilicis which coincided with HF concentrations of 6 to 8 micrograms/cu m and half-hourly values of SO2 of 1.5 to 2.0 mg/cu m. Only those treated with an 0.4% Wuxal-solution (six times in 14-day intervals) showed no injuries. Similar results were obtained with a spider mite (oligonychus ununguis) on picea omorika. Through treatment with pesticide, the pests and plant injuries could be averted. The sacchiphantes viridis louse was found in greater concentrations on parts protected from exposure by walls or other plants. The blastethia turionella on pinus montana occurred most frequently on heavily injured parts. The extent of pest occurrence among other things was influenced by weather, season, climatic, orographic, and topographic factors. Through efficient pest control, some injuries can be avoided.

56625

Engelbrecht, Abraham H. P. and C. Wynand Louw

HYDROGEN FLUORIDE INJURY IN SUGAR-CANE: SOME ULTRASTRUCTURAL CHANGES. Proc. Int. Clean Air Congr., 3rd, Duesseldorf, West Germany, 1973, p. A157-A159. 9 refs.

Mature sugar-cane plants were fumigated with controlled amounts of hydrogen fluoride and subsequently microscopically examined for ultrastructural changes. The first symptoms appeared as a fine stippling followed by irregular chlorotic mottling of the leaf margins and tips. These yellow chlorotic areas became necrotic and changed from yellow to brownish-red to dark brown, followed by a complete collapse of the mesophyll cells in the necrotic areas. First symptoms appeared after exposure to 12.9 micrograms/cu m HF; acute symptoms appeared at 23.0 micrograms/cu m; and severe necrotic symptoms and ultimate collapse occurred at a concentration of 105.0 micrograms/cu m. There was an overall decrease in the size of the chloroplasts and membrane system during the development of the chlorotic fluoride injury symptoms and an increase in the size and number of osmiophilic globules. The middle lamellae were swollen and became densely stained. The tonoplast disappeared during the change from reddish-brown to dark brown, and there was a separation of the primary cell walls at the middle lamellae. The plasma membrane disappeared in the necrotic condition, and the ground plasma was very granular. The chloroplasts were smaller than in the dark brown conditon, and the internal membranes as well as the plastid envelope started to disintegrate. Ribosomes were still present in the stroma, and the mitochondria were still intact.

56637

Edmunds, George F., Jr.

ECOLOGY OF BLACK PINELEAF SCALE (HOMOPTERA: DIASPIDIDAE). Environ Entomol., 2(5):768-777, Oct. 1973. 20 refs.

The ecology of black pineleaf scale which occurs on several species of pine and Douglas fir causing defoliation, discoloration of foliage, and reduced growth is reviewed. All known outbreaks of this scale have been caused by reduction in the population of Prosphaltella parasitoid that normally keeps the scale populations at very low densities. Abnormal mortality of Prospaltella has been found to be caused either by the presence of sorptive dusts or by drift of insecticides. High population densities of scale have been found mainly in areas of high dust fall resulting from industrial sources and roadways. No known causal relationships have been found to exist between atmospheric fluorides and the black pineleaf scale population density. Environmental improvement to conserve the Prospaltella parasitoids appears to be the most effective control measure. (Author abstract modified)

56655

Darley, Ellis F.

VEGETATION DAMAGE FROM AIR POLLUTION. In: Combustion-Generated Air Pollution. A Short Course on Combustion-Generated Air Pollution held at the University of California, Berkeley, September 22-26, 1969. Ernest S. Starkman (ed.), New York-London, Plenum Press, 1971, p. 245-255. 24 refs.

Principle air pollutants that adversely affect growth and development of vegetation are discussed. The typical injury symptom from peroxyacyl nitrates is a silvering, glazing, or otherwise metallic sheen on the lower surface of affected leaves. The symptoms from various PANs appear to be the same, but as the carbon number of the molecule increases so does the relative toxicity. Injury from ozone results in stippling, mottling, or a chlorosis that is confined to the upper surface of the leaf. Ozone has a similar effect on growth and cell wall metabolism compared to PAN; but, whereas short periods of darkness before, during, and after exposure prevent PAN damage, this is not so with ozone. The hydrocarbon ethylene affects flower production of ornamental species; the dry sepal injury to orchids is a prime example. The chief symptom of acute injury from sulfur dioxide is a white to tan bleaching of leaf tissues; the injury goes clear through the leaf and is not confined to one or the other surface. High concentrations of nitrogen dioxide produce similar effects, although recent experiments with a variety of plants exposed to nitrogen dioxide have demonstrated that concentrations of a few tenths ppm for several weeks can reduce growth as much as 35%. The typical symptomology of hydrogen fluoride poisoning is a necrosis of the margin of dicotyledonous of broad-leaved plants and of the tips of monocotyledonous, parallel-veined plants. Certain cement-kiln dusts have been shown to be toxic to plant leaves when deposited in the presence of free moisture. Dry dusts apparently do not have this affect but may interfere with the normal photosynthesis by the fact that they reduce th light reaching the leaf.

56788

Edmunds, George F., Jr. and Richard K. Allen

COMPARISON OF BLACK PINE LEAF SCALE POPULATION-DENSITY ON NORMAL PONDEROSA PINE AND THOSE WEAKENED BY OTHER AGENTS. Proc. Int. Congr. Entomol., 10th, Montreal, Canada, 1956, vol. 4, 1956 (1958).

A study of an infestation of black pine leaf scale, on ponderosa pine revealed a direct correlation between the degree of damage to the tree and the population density of the scale insects. Tests of the hypothesis that the scale insects more readily attacked trees damaged and weakened from other sources revealed the following: significantly lower average scale population density was noted on trees damaged by boron compounds used as weed killers than in trees not so damaged; no significant difference in average population density was noted between trees with moderate needle tip dieback, presumably caused by uptake of atmospheric fluorides, and trees not showing such damage; no significant difference was found in average scale population density between those trees with relatively high fluoride content and those with relatively low fluoride content; and no difference in average population density of black pine leaf scale was noted between trees damaged by infestations of dwarf mistletoe and trees not so damaged. Hence, damaged and presumably weakened trees are concluded to be no more susceptible to attack than trees not so damaged. (Author abstract modified)

56874

Vins, Bohuslav and R. Mrkva

INCREMENT STUDIES IN SCOTCH PINE STANDS IN THE VICINITY OF A FERTILIZER FACTORY. (Zuwachsuntersuchungen in Kiefernbestanden in der Umgebung einer Duengerfabrik). Text in German. Mitt. Forst. Bundesversv., no. 97:173-194, 1972. 8 refs. (Presented at the International Symposium of Forest Fume Damage Experts, 7th, Essen West Germany, Sept. 7-11, 1970.)

Scotch pine stands growing in sandstone in a very dry region of Southern Moravia in the vicinity of a fertilizer factory were studied. Atmospheric pollutants from the plant included sulfur dioxide, sulfuric acid mist, and fluorine compounds. Permanent plots were established in the surrounding pine stands,

with the plots being positioned so that the effects of decreasing amounts of pollution could be studied. Ring analyses were made on the cores from 100 sample trees in each of the five plots. Disturbances in the annual ring formation and reductions in growth were noted among the sample trees; similar disturbances were found in the smoke-damaged spruce stands of the Erzgebirge. The structural characteristics and health conditions of the trees were evaluated by computer.

56885

Knabe, Wilhelm

POLLUTION AND ITS THREAT TO FORESTS IN THE RUHR. (Immissionsbelastung und Immissionsgefahrdung der Walder im Ruhrgebiet). Text in German. Mitt. Forst. Bundesvers., no. 97:53-87, 1972. 30 refs. (Presented at the International Symposium of Forest Fume Damage Experts, 7th, Essen, West Germany, Sept. 7-11, 1970.)

Examples are given of air pollution damage to stands of spruces, pine, and broadleaved species in the forests of the Ruhr region. In the heart of the Ruhr, there are no longer any closed stands of spruce and pine. Although chronic damage occurs to broadleaved and coniferous species in the whole industrial region, the acute damage to the broadleaved species is concentrated in the region containing the chemical factories, aluminum works, galvanizing works, glass factories, and burning tips. The damage is frequently caused by halogen compounds. The causes of chronic fume damage to the forests are sulfur dioxide, fluorine compounds, oxidants, and dusts, the dust affecting the foliage by blocking light and reducing assimilation, and by affecting the roots by accumulating injurious substances in the soil. The danger of pollution to conifer forests in North Rhine/Westphalia is estimated on the basis of an SO2 measurement program, the SO2 being regarded both as an injurious substance and as an indicator of the general air pollution index. The basis for predicting the risk of planting conifers is the frequency of occurrence of certain growing-season mean values. In the heart of the region, a growing-season mean value of 0.08 mg SO2/cu m was exceeded in the last 3 out of 4 years, and, in the marginal areas of the region, it was reached or exceeded in 1 year out of 4.

56963

Horvath, Iwan

EFFECT OF FLUORINE COMPOUNDS ON THE DRY MATTER PRODUCTION OF BUCKWHEAT. (Einfluss von Fluorverbindunger auf die Trockensubstanzproduktion von Buchweizen). Text in German. Mitt. Forst. Bundesvers., no. 97:335-351, 1972. 17 refs. (Presented at the International Symposium of Forest Fume Damage Experts, 7th, Essen, West Germany, Sept. 7-11, 1970.)

The effect of fluorine compounds applied to the soil before sowing, at the start of flowering, and during the ripening of the first fruits was evaluated according to the dry-matter production of Fagopyrum esculentum M (Doxanska variety). The application of fluorine in the rooting medium of the plants at different stages in their ontogeny produced results which indicated that the reduction in dry matter depended, inter alia, on the form in which the fluorine was applied to the soil. Under greenhouse conditions and on standard soil, the maximum inhibiting effect was found with sodium fluoride; the effect was less when fluorine was applied as potassium fluoride or calcium fluoride. In addition, the reduction in dry-matter production was more marked when the individual fluorides were applied before sowing. Increasing the fluorine level in the soil during flowering and during ripening of the first fruits did not cause significant reductions in dry matter, except in the case of sodium fluoride. The maximum inhibiting effect of sodium fluoride occurred when it was applied to the soil at the start of flowering; the effect was less when it was applied before sowing, and was not very significant when it was applied during the ripening of the first fruits. An increase in dry matter and leaf area was observed after a single application of fluorine on the 20th day of growth, indicating that calcium fluoride does not significantly affect the physiological processes of buckwheat during the first 6 weeks after application; the effect of sodium fluoride was quite different. The occurrence of necrotic leaves and the death of the most susceptible individuals were associated with a significant decrease in the formation of leaf surface area and with the reduction of dry-matter production. The most resistant individuals, as indicated by the responses to fluorine treatment, equalled or often even surpassed the control plants.

57475

Bohne, Helmut

CHANGES OF THE LANDSCAPE CAUSED BY INDUSTRIAL SMOKE ACIDS. (Zmeny v krajine zpusobene emitovanymi kyselinami). TERPLAN-Statni ustav pro uzemni planovani, Ustav krajinne ekologie CSAV, Bioindikatory Deteriorizace Krajiny, Sbornik Z Mezinarodni Konference, Prague, Czechoslovakia, 1971, p. 14-17. (Sept.)

The influence of industrial smoke emissions of sulfur dioxide, fluorine, and chlorine on landscape is examined. Sulfur dioxide emission has been estimated to cause 80% of the plant damage found near industrial surroundings according to the literature, but more recent evidence has pointed to fluorine-containing exhaust as being the main culprit of smoke damage. Two examples are presented in favor of the latter hypothesis. Fluorine- containing exhausts have been found to cause damage in gladiolas, horse-chestnuts, damson plums, apricots, forest plants; leaf burning and permanent damage have been common. Plant damage has also been observed in the vicinity of chlorine-emitting facilities. Growth depression, bleached or lightened leaves, and necroses have been observed. Damage to pear leaves from chlorine appeared as ill defined, brown necroses in contrast to the sharply defined black-brown edges resulting from fluorine damage.

57716

Holub, Zdenek and Olga Kontrisova

PHYTOINDICATION OF AIR POLLUTION BY FLUORINE IMMISSIONS. (Phytoindikation der Luftverunreinigung durch fluorimmissionen). Text in German. Biologia, 28(10):827-836, 1973. 24 refs.

A method of leaf analysis for studying the content of toxic substances in plant leaves is described. It can be used to measure areas polluted with fluorine. Analyses of naturally occurring plant species are suitable in regions with higher fluorine content in the atmosphere. Lower concentrations of fluorine in the air are indicated in a more sensible way by the fluorine content of lichens or of plants that have been cultivated in more or less standardized conditions.

57810

Dept. of Agriculture, Upper Darby, Pa., Northeastern Area, State and Private Forestry

AIR POLLUTION DAMAGES TREES. Washington, D. C., U. S. Government Printing Office, 1973, 34p. 37 refs.

An examination of air pollution damage to trees indicates that sulfur dioxide and ozone are probably the most important phytotoxic air pollutants in the northeast, though fluorides,

chiefly in the form of the gas hydrogen fluoride, also occur. Injury on conifer needles from these pollutants is often manifested as necrosis of the needle tip or the entire needle. Ozone also causes a chlorotic mottle of needles. Most pollutants cause more specific symptoms on broadleaved trees. Sulfur dioxide symptoms generally appear on such trees as an interveinal necrosis, with the injured tissue being a light brown. Ozone causes a reddish-purple stipple or brown to white flecks of the upper leaf surface. Fluoride injury is usually restricted to the margins of the leaf where toxic accumulations of this pollutant cause the tissues to turn brown and die. Minor pollutants cause a variety of symptoms. Air pollution injury to trees is most prevalent during inversions, i.e., meteorological conditions which do not allow pollutant-laden air to rise and disperse. (Author summary modified)

57859

Dost, Frank N., D. J. Reed, and C. H. Wang

STUDIES ON ENVIRONMENTAL POLLUTION BY MISSILE PROPELLANTS. Oregon State Univ., Corvallis Radiation Center, Air Force Systems Command/Aerospace Medical Research Lab. Contract AF33(615)-1767, Proj. 6302, Task 630204, Work Unit 630204001, AMRL-TR-68-85, 28p., Feb. 1969. 3 refs.

Field evaluation of the effects of inorganic fluoride oxidizing agents accidentally released into the environment are discussed. Information is derived primarily from research previously published. The compounds reviewed are nitrogen trifluoride (NF3), tetrafluorohydrazine (N2F4), oxygen difluoride (OF2), and the interhalogens chlorine trifluoride (ClF3), chlorine pentafluoride (ClF5), and bromine pentafluoride (BrF5). Nitrogen trifluoride has no effect on plants, fish or microorganisms. High concentrations cause reversible toxicity in mammals. Tetrafluorohydrazine has limited effects on plants and its reaction products are fairly harmless to fish. Mammalian toxicity is moderate but reversible. Oxygen difluoride is highly toxic to plants, but does not appreciably harm microbes or fish unless partial pressure remains high. It causes irreversible damage to mammals at very low doses, and as yet no successful decontaminant has been found. The interhalogens are highly toxic to plants. A possibly productive approach to decontamination of the highly toxic OF2 may be through the immediate reaction of the spilled gas by reagents distributed through the cloud, at a time when concentration is high enough to permit relatively easy reaction in a limited area. The decontamination of spilled interhalogens should be easier to accomplish, since they react with almost any material they encounter. Their reactive aqueous solutions must be dealt with as well, but if the waterborne interhalogen reaction products are eluted or percolated through soil, almost all living elements in the environment will be protected. The problem of quickly and safely destroying each of the inorganic fluoride oxidizing agents in air, leaving products which may be dealt with on a non-emergency basis, is being studied.

58381

Lisicky, Mikulas

REMARKS ON THE INFLUENCE OF FLUORINE EXHALATIONS UPON THE MOLLUSKS IN THE SURROUNDINGS OF ZLAR NAD HRONOM. (Bermerkungen zur Auswirking der Fluorexhalationen auf die Malakofauna in der Umgebung von Zlar nad Hronom). Text in German. Biologia, 28(11):919-924, 1973. 7 refs.

Seventeen localities in the area contaminated by fluorine and its immediate vicinity were investigated. The malacocenoses in stagnant water and in the forest were most injured. Two hypotheses concerning the possible influence of hydrogen fluoride on the water-mollusks are advanced: direct effect, i.e., corrosion of the conch; and indirect effect-the HF blocks the calcium and the only way out for the snails is to gnaw the conches. In the contaminated area the malacocenoses trend to show high dominance of one euryoecic species. (Author abstract)

58506

Keller, Th.

TRANSLOCATION OF FLUORIDE IN WOODY PLANTS. Fluoride, 7(1):31-35, Jan. 1974. 5 refs.

Foliage of different species of forest trees was analyzed for its fluoride content. The foliage of plants which had been exposed to fluoride exhalates of an aluminum smelter for one to many years was analyzed after it had been allowed to flush and develop in pure air. All samples of the foliage of trees near the factory had increased fluoride content in dry matter as compared to controls. The foliage near the smelter contained 11-136 ppm F in dry matter, whereas controls contained 3-14 ppm. The level of fluoride in first leaves formed in the spring was higher than that in foliage formed later in the year, a fact indicative of depletion of reserves. New foliage of deciduous trees which had been exposed to fluoride fumes in winter exclusively also contained increased amounts of fluoride, a fact which indicates mobilization of fluoride entering the tree via the bark. These data prove that fluoride is being translocated in woody plants. (Author abstract modified)

58507

Kay, E.

AN INQUIRY INTO THE DISTRIBUTION OF FLUORIDE IN THE ENVIRONMENT OF GARRISON, MONTANA. Fluoride, 7(1):7-31, Jan. 1974. 31 refs.

In the fall of 1971 and 1972, the extent and severity of fluoride contamination in the vicinity of Garrison, Montana was determined. Assays of the fluoride content of indigenous flora and fauna were utilized to establish the effectiveness of the air pollution control equipment of a fluoride-emitting industrial facility. Vegetation samples included forage, shrubs, coniferous and deciduous tree species, as well as various species of small mammals in a directional pattern throughout the study area were analyzed for fluoride and compared with control samples collected throughout western Montana. Analysis by individual species allowed comparison of the ratio of fluoride accumulation between species. Fluoride levels in vegetation and small mammals were also correlated. Isopol maps of fluoride concentrations in vegetation were constructed. Wide differences between different species were observed. Fluoride concentrations in different species were compared and presented graphically. (Author abstract)

58777

Oshina, Tatsuo, Ryuichi Sugai, Yoshimaru Fujieda, Takaaki Yanaka, and Nobuo Shibuta

FLUORIDE POLLUTION ON PLANTS IN AREA NEAR AN ALUMINUM FACTORY. (Arumi seiren kojo shunhen ni okeru fukkabutsu ni yoru nosakubutsu osen). Text in Japanese. Taiki Osen Kenkyu (J. Japan. Soc. Air Pollution), 8(3):543, Oct. 1973. (Presented at the Japan. Society of Air Pollution, Annual Meeting, 14th, Fukushima, Japan, Nov. 6-8, 1973, Paper 269.)

Fluoride accumulation in produce was examined in area near an aluminum refining plant to obtain basic data for the health care of residents in the area. The relationship between F accumulation in produce with the distance and direction from the

emission source, the species of produce, and the degree of air pollution were examined. Edible parts of turnip, eggplant, Chinese cabbage, potatoes, spinach, green scallions, cucumbers, and some of their leaves were checked at various distances and directions from the emission source; the area was divided by environmental quality classifications and the F content in the leaves and produce were examined. The measurements were taken by the ion electrode method after burning and distillation of the specimens. Fruit and root vegetables did not have high accumulation at any location, but the leaves had high F content even at a distance of 5 km, compared to the control area. When not taking the wind direction into consideration, the F content varied by the distance but lacked significance statistically. When studied by air quality classifications, the statistics showed a clear and significant relationship between F accumulation and the environment.

58941

Matsuoka, Yoshihiro, Tsuyoshi Takasaki, and Osamu Udagawa

FLUORINE ACCUMULATION IN RICE PLANT LEAVES WITH AIR-BORNE FLUORIDE. (Fussokei taiki osen ni yoru suitoyochu no fusso shuseki ni tsuite). Text in Japanese. Chiba-ken Nogyo Shikenjo Kenkyu Hokoku (Bull. Chiba-Ken Agr. Exp. Sta.), no. 12:57-62, March 1972. 21 refs.

Injury of rice plants due to fluorine emitted by aluminum refining and phosphate fertilizer plants in the Keiyo heavy industrial district of Chiba Prefecture in July 1969 and July 1970 was studied. The fluorine determination by AOAC procedure was unsuitable for siliceous vegetation such as rice because of the large amount of silica contained. An improved procedure of fusing calcination with sodium carbonate was more accurate. The new procedure was used to determine F in this investigation. Fluorine caused leaf blade necrosis, but scarcely damaged the leaf sheath before the heading stage. Remarkable injury appeared on the tip of the leaf blade, but was slight on the lower portion of the leaf. The leaf also changed color. Irregularly shaped chlorotic spots appeared in the healthy tissues of severely injured leaves. A large amount of fluorine was contained in the rice leaf, but only a little was found in the stem, leaf sheath, and ear. Concentrations of F in the leaf differs according to the leaf position on the stem. The highest concentration of F was contained in the most severely damaged leaves. Fluorine was scarcely translocated to stem or ear from the leaf. Seven hundred ppm of F on a dry weight basis was contained in the tip of the leaf blade, and 80 ppm F in the base of the leaf. Fifty-six percent of the total F was accumulated in the tip of the leaf. Almost all of the F was accumulated in necrotic tissue of the injured leaf. The remarkable rice injury occurred 1-2 km downwind from the major source of F, and slight injury occurred within 3 to 4 km. From the leaf analysis, F was confirmed to be absorbed in leaves within 4-5 km where visible injury was not recognized.

59028

Dochinger, Leon S.

IMPACT OF AIR POLLUTION ON FOREST TREE PLANTINGS. Soil Conservation Society of America, Earth Around Us, Proc. Soil Conserv. Soc. Am., Annu. Meet., 27th, Portland, Oreg., 1972, p. 134-138. 9 refs. (Aug. 6-9.)

Phytotoxicants include ozone, nitrogen oxides, sulfur dioxide, fluorides, chlorine, hydrogen chloride, ammonia, and particulate matter. The sources and symptoms of these pollutants are reviewed. The effects of these pollutants on both broad-leaved and coniferous trees, on forest tree plantings, and on Christmas tree farms are mentioned. Acute and chronic effects are discussed.

59184

Gilbert, Oliver L.

NEW TASKS FOR LOWLY PLANTS. New Scientist, vol. 46:288-289, May 1970. 1 ref.

The occurrence and behavior of easily identified lichens and bryophytes can be used as an index of sulfur dioxide pollution, since SO2 kills them. As these lower plants range from very sensitive to highly resistant, they can be arranged to form a scale from which levels of SO2 can be estimated. Also, by mapping the distribution of selected species, the size and shape of an area affected by pollution can be determined. Ideally, these indicator species should be widespread, easy to recognize, and among them show a wide range of sensitivity so that the rate of fall off of pollution can be assessed. A table of SO2 estimates correlated to plant incidence is given, along with some examples of application of the principle. Pollutants other than SO2 have only barely detectable effects on lower plants, however, observations around aluminum smelters suggest that lichens are also useful indicators of fluorine pollution.

59198

Preuss, Peter W. and Leonard H. Weinstein

STUDIES ON FLUORO-ORGANIC COMPOUNDS IN PLANTS. II. DEFLUORINATION OF FLUOROACETATE. Contrib. Boyce Thompson Inst., 24(7):151-156, April-June, 1969. 13 refs.

Experiments were conducted to confirm that germinating peanut seeds contain enzymes which split the carbon-fluorine bond of fluoracetic acid, an extremely toxic compound to animals, and to determine if fluoracetic acid can be metabolized to fluorofatty acids in Acacia georginae. About 15% of the fluorine supplied to germinating peanut seeds as sodium fluoroacetate was found in the inorganic form in the seedlings or in the incubation medium after 48 hr, indicating that defluorination is an important part of the metabolism of fluoroacetate by higher plants. Only 2-5% was detected after incubation of boiled seeds. The gas chromatographic pattern of fatty acids of control and fluoroacetate-treated Acacia seeds was the same; and analysis of each peak by mass spectrometry provided no evidence for the presence of a fluorine atom attached to the fatty acids, indicating defluorination is an early step in the metabolism of fluoroacetate in this species. (Author abstract modified)

59327

Nakamura, Akira, Shinichi Chiyo, and Makoto Yao

ON SULFUR OXIDES AIR POLLUTION IN TOMAKOMAI, KOKKAIDO. (Hokkaido Tomakomai chiku ni okeru io sankabutsu osen ni tsuite (dailppo)). Text in Japanese. Taiki Osen Kenkyu (J. Japan. Soc. Air Pollution), 8(3):494, Oct. 1973. (Presented at the Japan. Society of Air Pollution, Annual Meeting, 14th, Fukushima, Japan, Nov. 6-8, 1973, Paper 224.)

The Tomakomai industrial site at present emits about 6600 N cu m/hr of sulfur oxides from its paper industries and thermal power plants. Further development of petroleum refining, petroleum chemical, and electric power plants in the eastern development site will increase the emissions. In order to control the further damages of valuable, rare plants in the eastern area, the sulfur content in plant leaves were measured. Samples of oak, Japanese oak, white birch, sage brush and some others were taken in July, August, and early September; they were washed, dried, and crushed, and the total sulfur and soluble sulfur in particles smaller than 40 mesh were quantitated by the barium chloride weight method. The patterns of SOx concentration in the air and soluble sulfur in leaves had a

definite realtionship, though the soil sulfur content and the weather must be taken into consideration before using those plants as air pollution indicators. At present, sage brush sampled in East Tomakomai has 0.05-0.08% of soluble sulfur; but in Tomakomai and North Tomakomai, the content ranges 0.25-0.5%. In these areas, visible damages of azalea are noted and in one area, the plant growth is impaired by fluorides. The intake of soluble sulfur in plants is lower in these areas in proportion to the SOx concentration in the air.

59935

Crocker, Thomas D.

IN POLK AND HILLSBOROUGH COUNTIES, FLORIDA. Bull. At. Sci., 1965:17-19, June 1965.

Air pollution in the citrus growing area in Polk and Hillsborough counties, Florida, is described. This area has one of the world s largest and richest phosphate deposits, and therefore a large phosphate industry grew in the area. It supplies over 75% of the nation s phosphate rock. Expanded food and fiber production in the area caused removal of most of the phosphorus in the soil used for agriculture. Therefore fertilizers such as triple superphosphate were applied in the area. This resulted in increased fertilizer production at the phosphate plants, and thus, increased air pollution due to fluorides. Cattle in the area were affected by fluorosis, and citrus showed chlorosis due to the gaseous fluorides. Some areas generally had concentrations of 10 ppb fluorides in the air. The air pollution was worse in the winter and early spring; these months also had the greatest occurrence of cattle and citrus damage. Due to combined governmental and industrial efforts, fluoride emissions were reduced from 33,000 pounds/day (winter of 1961-1962) to 13,000 lbs/day (winter of 1963-1964). Since 1959, air pollution control equipment costing $16 million has been added. A new, pollution-free plant costing $20 million replaced an old one. A new proposal is being considered to limit fluoride emissions further.

59947

Scholl, Gerhard

A BIOLOGICAL METHOD OF DETERMINING FLUORINE COMPOUNDS IN ATMOSPHERIC POLLUTION. (Ein Biologisches Verfahren zum Nachweis von Fluorverbindungen in Immissionen). Text in German. Mitt. Forst. Bundesvers., vol. 97:255-269, 1972. 15 refs. (Presented at the International Symposium of Forest Fumes Damage Experts, 7th, Essen, West Germany, Sept. 7-11, 1970.)

A grass culture method for determining the origin and distribution of fluorine compounds in the air has recently been developed. With this method, the accumulation of fluorine in the test plants is used as the measured value. The only plants which are suitable are those which can accumulate the toxic substance in large amounts without showing visible external symptoms of damage or a depression in growth. Certain grasses, such as Lolium multiflorum and L. perenne, are relatively insensitive to fluorine compounds in the air. These indicator plants are placed for a defined period in a standardized growth substrate with comparable nutrient and water supplies in the vicinity of a pollution source. The plant samples obtained at the end of the exposure period are analyzed for their fluorine content. On the basis of the fluorine values obtained (in mg/100 g dry matter), it is possible to assess the origin and distribution of fluorine compounds in the air and to make a prediction of the fluorine hazard to grazing cattle. Details of the method and the results of some practical field investigations are reported.

60559

Treshow, Michael, Gerald Dean, and Frances M. Harner

STIMULATION OF TOBACCO MOSAIC VIRUS-INDUCED LESIONS ON BEAN BY FLUORIDE. Phytopathology, vol. 56:756-758, 1967. 4 refs.

The possible effect of fluoride on the number of local lesions developing on Pinto bean leaves following inoculation with tobacco mosaic virus was studied. Plants were grown in fumigation chambers in which atmospheric fluoride concentrations ranged from 0.2 to 2.5 micrograms/cu m; foliar fluoride concentrations ranged from 20 to 637 ppm. The number of lesions increased with foliar fluoride concentrations up to 500 ppm, above which the number decreased. Since the number of lesions that developed varied among fumigations, the lesion numbers were converted to percentages of the control. Lesion numbers on plants in the unfumigated chamber served as a control, and these values represented 100%. The numbers of lesions on the leaves with fluoride concentrations of 100-200, 200-300, and 300-500 ppm were 121, 157, and 179% of the control, respectively. The correlation coefficient of 0.802 between fluoride concentrations up to 300 ppm and lesion numbers was significant at the 1% level. When lesion numbers were grouped according to leaf age, irrespective of fluoride concentration, lesions were most prevalent on the first trifoliolate leaves. The number of lesions diminished on the older leaves and on older plants. When leaves are fully developed and plants reached the four- to five-leaf stage, no lesions could be induced. (Author abstract)

60560

Woltz, S. S.

FLUORIDE TOXICITY IN GLADIOLUS AND METHODS OF AMELIORATION. Proc. Florida State Hort. Soc., vol. 75.469-471, 1962. 6 refs.

The protection of gladioli from fluoride by spraying is described. Fluorine leaf scorch symptoms were identified using specimens fumigated with 0, 0.48, 0.95, 1.9, 3.8, and 7.6 mg hydrofluoric acid. The leaf-tips and margins turned grayish-green the second day following exposure; by the third day the leaves turned grayish white or tan; by the end of a week the damaged area had a burned appearance with tan to dark brown color. In a field experiment, plants were exposed to fluoride sprays as pesticides under controlled conditions. Calcium, manganese, and magnesium had protective effects through the inhibition of metal-requiring enzymes. The field experiment showed leaf scorch systems were produced on gladioli by sodium fluoride and hydrofluoric spray treatments, the effects of HF were almost as great, even though after drying any unreacted HF was lost to the atmosphere. No reduction in foliar toxicity resulted from soil applications of calcium sulfate, apparently due to a greater native calcium supply. Both sodium fluoride and HF were effective in foliar sprays used to stimulated fluoride leaf scorch.

60595

Garrec, J.-P. and A. Fourcy

RAPID ANALYSIS OF FLUORINE DEPOSITS ON VEGETATION GROWING IN POLLUTED AREAS BY RADIOACTIVATION WITH 14MEV NEUTRONS. (Analyse rapide par radioactivation sous neutrons de 14 MeV des depots de fluor sur la vegetation en zone pollue). Text in French. 3rd European Fluorine Chemistry Symposium, Aix-en-Provence, France, 8p., July 1970. 11 refs.

A method for the quantitative analysis of fluorine deposits on plants by neutron activation at 14 MeV is described. The plant samples to be analyzed are dried at 70 C, crushed, and in-

troduced into a polyethylene container for irradiation for a present duration at 14 MeV for 1 min and subsequent counting for 30 sec, the neutron yield being 30,000,000,000 neutrons/sec/4 pi. The quantity of the irradiated fluorine is determined from the net surface of the total absorption peak at 200 keV against a previously irradiated fluorine samples used as a reference. Comparative chemical and neutron activation analyses of apple-tree leaves from a fluorine-exposed area showed good agreement between the results of the chemical and neutron activation analyses. The neutron activation analysis has the advantage of being rapid, since one complete analytical procedure takes about 5 min. However, it is not suitable for the determination of small quantities of fluorine.

60690

Leblanc, Fabius, Dhruva N. Rao, and Gilberte Comeau

INDICES OF ATMOSPHERIC PURITY AND FLUORIDE POLLUTION PATTERN IN ARVIDA, QUEBEC. Can. J. Botany, 50(5):991-998, 1972. 11 refs.

Indices of atmospheric purity (IAP) of 42 sites located in all directions from the aluminum factory at Arvida and spread out in about 250 sq km area, were determined on the basis of phytosociology of epiphytes of Populus balsamifera. These index values ranging from 0 to 103 were arranged into six groups and the investigated area was accordingly delineated into six IAP zones to represent areas with different levels of fluoride pollution. A relative picture of the approximate limits of F contamination in different zones is obtained by the F accumulation in Parmelia sulcata thalli transplated at various sites in the area. (Author abstract)

60760

Jones, L. H. P. and D. W. Cowling

THE EFFECTS OF SOME AIR POLLUTANTS ON FARM ANIMALS. Preprint, National Society for Clean Air, Brighton (England), 18p., 1973. 32 refs. (Presented at the National Society for Clean Air, Annual Conference, 40th, Torquay, England, Oct. 15-19, 1973.)

A review is presented on the effects of fluorides and various metal dusts on farm animals. Fluorides reportedly cause more damage to domestic animals than any other air pollutant on a world-wide basis. The fluoride content of forage plants growing in air polluted with the halogen compounds greatly increases either through the absorption of gasous fluoride (hydrogen fluoride) or by deposition of particulate fluorides; concentrations as high as 292 ppm are reported for grass on a farm in Stoke-on-Trent. The most sensitive sign that an animal is absorbing high amounts of fluoride is mottling of the teeth which occurs with intakes too low to produce the symptoms of more severe fluorosis. Arsenic toxicosis in sheep and cattle grazing in the vicinity of copper smelters is a problem particularly evident during the first 40 years of the present century. Industrial molybdenosis, a more recent problem, results in progressive emaciation, accompanied in all cases by diarrhea; high intakes of molybdenum antagonize the metabolism of copper, especially in the presence of high sulfate intake. Post morten examinations of cattle and horses grazing in lead-contaminated areas indicate high concentrations of both lead and cadmium in the kidney, suggesting that both elements are involved.

60907

Young, Michael John

THE EFFECTS OF GASEOUS FLUORIDE ON DELICIOUS AND GOLDEN DELICIOUS APPLES. Washington State Univ., Pullman, Dept. of Horticulture, Thesis (Ph.D.), Ann Arbor, Univ. Microfilms, Inc., order no. 73-29,311, 1973, 82p. 46 refs.

Atmospheric fluorides were monitored in apple and other fruit orchards around two adjacent sources of fluoride emissions in the Wenatchee, Washington fruit growing area, and Delicious and Golden Delicious trees were fumigated with low (4.6-4.7 micrograms F/cu m) and high (7.8-9.0 micrograms F/cu m) fluoride levels once, twice, or three times a week. The effects of fluorides on fruit trees were then determined. Exposure of limed filter papers was a more sensitive method of detecting ambient fluorides than analysis of apple tree foliage. However, both methods were adequate in the determination of the fluoride distribution pattern in the study area. Considerably higher levels of fluoride were detected at sampling sites downwind of the emission sources. Fluoride-induced tip necrosis on apple leaves was observed in one orchard where a mean seasonal limed filter paper value of 82.4 micrograms F/d sq m/mo and 22.5 F in the washed foliage were recorded. Tip necrosis increased as the F level and frequency of exposure increased. Leaf respiration was inhibited at the lower but not the higher F fumigation level. Fruit respiration was stimulated to equal levels by the two F concentrations used. A trend toward increased inhibition of fruit ethylene production at lower exposure factors (concentration times time) was observed. The loss of green color in the skin of treated fruits was retarded relative to an increase in the F level and the exposure frequency. With the exception of leaf respiration, where an inverse relationship was found, the degree of response with respect to leaf injury, fruit respiration, and color were directly affected by the exposure factor used. Within the scope of this study, fruit shape, firmness, and soluble solids were not affected by the treatments. (Author abstract modified)

60913

Materna, Jan

WAYS OF DETERMINING DAMAGES TO FOREST STANDS CAUSED BY INDUSTRIAL AIR POLLUTION. (Moznosti prukazu skod pushobenych prumyslovymi exhalaty v lesnich porostech). Text in Czech. Les. Pr., 43(5):212-216, May 1964.

Solid pollutants affect trees indirectly, mainly by adhering to the leaves and thus depriving them of the benefits of the sunlight. They are, however, less injurious than the gaseous pollutants. The worst offender among these is sulfur dioxide because it is so wide-spread; the effects of chlorides and fluorides are equally as bad, although these elements do not occur as frequently in the atmosphere. Nitrogen oxides are injurious only in the immediate vicinity of the source. Conifers are seriously affected by sulfur dioxide; their needles are discolored, become dry and drop off. Older growth is affected first. Spruce shows serious damage after prolonged exposure to as little as 0.5 mg silicon dioxide/cy m air. Fir and larch are also very sensitive; pine is less sensitive. Broad-leaved trees are far more resistant to high pollutant concentrations which cause necrosis on the periphery of the leaf and gradually extend to the interior under prolonged attack. Diagnostic methods include determination of the pollutant concentration in the foliage and in the soil. An important factor is the chlorophyll content; SO2 reduces its overall content, and changes the ratio a:b chlorophyll. The affected foliage contains also pheophytin, which is formed by magnesium abstraction from chlorophyll. In the case of conifers, a quantitative diagnostic tool is the Haertel test (hot water extraction of the needles, measuring of the turbidity of the extract). Another simple test is the sun test in which twigs are cut off and exposed to sunlight. Twigs from trees affected by SO2 dry much faster than twigs from healthy trees.

60957

Keller, Theodor

AIR POLLUTION EFFECTS ON VEGETATION. (Auswirkungen der Luftverunreinigungen auf die Vegetation). Text in German. Staedtehygiene (Uelzen/Hamburg), 22(6):130-136, June 1971. 16 refs

The dust filtering effect of vegetation, and the effects of air pollutants, especially gaseous ones, on vegetation in general, and on forests in particular, are reviewed. Vegetation, and especially forests, have enormous dust filtering capacity whereby they are able to considerably reduce the atmospherice dust concentrations without suffering damage themselves, provided the dusts filtered out are inert. While most dusts are harmless for vegetation, gaseous pollutants, especially sulfur dioxide and fluorine, cause serious damages in forests by interfering with cellular metabolism and assimilation, and causing chlorosis, necrosis, or even death. Assimilation and forest production can be seriously damaged even when there are no visible signs of injury. For such reasons, the maximum allowable SO2 concentration should be substantially lowered from the present level of 0.2 ppm. The resistance of plants to SO2 greatly varies depending on species, season, period of vegetation, and daytime. Specimens of the same species are usually less sensitive during night and in winter, and so are the youngest and oldest leaves of plants. Automotive emissions, partly responsible for smog formation, represent a potential source of forest damage in Switzerland. Apart from the development of high-efficiency emission control equipment, fuel and flue gas desulfurization, as well as technological improvements in industries with the aim of emission abatement, vegetation damages due to air pollution can be reduced considerably by the selection of resistant species and fertilization.

60961

Keller, Theodor

ON THE PHYTOTOXICITY OF PARTICULATE FLUORINE COMPOUNDS. (Zur Phytotoxizitaet staubfoermiger Fluor-Verbindungen). Text in German. Staub, Reinhaltung Luft, 33(10):395-397, Oct. 1973. 8 refs.

The effects of sodium fluoride, calcium fluoride, and cryolite on seedlings of Pinus silvestris, Pseudotsuga menziesii, and Betula verrucosa were studied in laboratory experiments. The fluorine compounds were sprayed on the plants in the form of small particles. Sodium fluoride alone induced visible symptoms of partial or total necrosis of the needles in Pinus silvestris. All dusts caused a statistically significant depression of photosynthesis in birch. Calcium fluoride and cryolite may also exert a phytotoxic action classified as invisible injury. In the tested conifera, the depression of photosynthesis was statistically not significant in the absence of visible symptoms of injury. The reduced toxicity of these dusts in conifera is most probably due to the well-developed cuticula and the resin and wax excretions by the needles. The increased susceptibility of conifera growing around aluminum works may be due to gaseous fluorine compounds. All dusts had an increased toxicity and photosynthesis-depressing effect in air with high relative humidity.

61000

Kahl, Stanislaw and Aleksandra Klewska

FLUORINE CONTENT OF THE MILK FROM COWS IN THE REGION OF ALUMINUM PLANTS. (Zawartosc fluoru w mleku krow z okolic huty aluminum). Text in Polish. Roczniki Panstawowego Zakladu Higi, 25(1): 97-103, 1974. 21 refs.

The fluorine content in the milk of cows from farms situated 2-3 km from aluminum plants was determined. The experiments covered the area where fluorine contamination of air, rain water, and green forage was found. Fluorisis occurred in 79.4% of the cows under investigation. Fluorine was isolated from milk by a microdiffusion technique and determined colorimetrically with alizarin complexonate and lantanium nitrate. A marked increase (P greater than 0.001) was found in the fluorine content of milk from the cows exposed to fluorine (88.1 micrograms/100 ml) compared with that from the controls (35.5 micrograms/100 ml). In addition, seasonal variation in the fluorine content of milk was connected with the amount of precipitation and with variations of fluorine content in green forage. The highest values were in winter months (117.9 micrograms/100 ml), and the lowest ones were in June (63.8 micrograms/100 ml). The fluorine content in milk, up to 100 micrograms/100 ml (equal to 1 ppm) seemed to have no adverse effect on people and animals, since it did not exceed the permissible limits for fluorinated water, while some hazard may be expected in about 5% of the cows with fluorine content of milk exceeding 200 micrograms/100 ml (equal to 2 ppm).

61410

Taniyama, Tetsuro and Hiroki Arikado

STUDIES ON THE MECHANISM OF INJURIOUS EFFECTS OF TOXIC GASES ON CROP PLANTS. VIII. SYMPTOMS OF INJURY AND STOMATAL APERTURES OF TULIP PLANT EXPOSED TO SULFUR DIOXIDE AND HYDROGEN FLUORIDE. (Sakumotsu no gasu shogai no kansuru kenkyu: Dai8ho: Fukkasuiso oyobi aryusan gaku ga churippu ni oyobosu shogai no jittai narabi ni kiko kaido ni oyobosu eikyo). Text in Japanese. Nippon Sakumotsu Gakkai Kiji (Proc. Crop Sci. Soc. Japan), 39(4): 525-532, Dec. 1970. 13 refs.

The injurious effects of sulfur dioxide and hydrogen fluoride in the atmosphere on stomatal apertures of tulip plants of the flowering stage were investigated. Injuries by 100 ppm SO2 and HF were observed on leaf, floral axis, and petal of the plant, especially whole leaves, which were severely damaged. Injuries at concentrations of 30 ppm and below were observed only on the leaf. The leaf was changed in color from green to white by SO2 and from green to greyish brown by HF. There was a significant difference in susceptibility between the injury by SO2 and HF; the leaf was more sensitive to SO2. From the result of estimation of stomatal number in the position and the portion of leaf, it is suggested that higher susceptibility of the leaf than that of the floral axis was due to the greater number of stomata per unit area of the leaf. The injury symptom in a leaf developed gradually from the tip to the central and base portions.

61496

Vetter, Heinz

POLLUTION AND INJURIES BY HEAVY METALS IN THE VICINITY OF A LEAD AND ZINC PLANT IN LOWER SAXONY. (Belastungen und Schaeden durch Schwermetalle in der Nache einer Blei- und Zinkhuette in Neidersachsen). Text in German. Staub, Reinhaltung Luft, 34(1):10-11, Jan. 1974. 2 refs.

The dusts emitted at 1 to 3 km distance from the lead and zinc plant in Lower Saxony from 1971 on contained about 15% Zn, 12% Pb, 1.4% fluoride, 0.2% copper, 0.15% arsenic and 0.09% cadmium. During the time of filter break-down in spring 1972 the average Pb concentration at 1.5 km distance was about 12 mg and after repair of the filter 1 mg/sq m/day. Systematic measurements of the lead and zinc concentration in soil and plants to a distance of 12 km revealed that the lead and zinc concentrations in soil were up from thy normal 10 ppm to 34 ppm Pb and 70 ppm Zn. At 12 km distance the grass contained

in April about 100 times higher and in May about 10 times higher Pb concentrations than normal. At 1 km distance the Pb concentration in the grass rose to 23,000 ppm in April, dropped to 2000 ppm in May and to 50 ppm in September. The Zn concentration rose to 7000 ppm in April and dropped by September to 1000 ppm. Injuries of cattle observed in the vicinity of the plant were found to be mainly due to the zinc and lead ingested with the food. Feeding experiments with a Zn concentration triple the concentration of lead showed that Zn was more harmful than lead. Concentration limits for Zn are therefore as important as those for lead.

61834

Taoda, H.

ON THE INFLUENCE OF AIR POLLUTION TO PLANTS AND THE METHOD OF ITS INVESTIGATION. (Taiki osen ga shokubutsu ni ataeru eikyo to sono chosa hoho). Text in Japanese. Nihon Seitai Gakkai Shi (Jap. J. Ecol.), 23(2):81-89, April 1973. 20 refs.

Sulfur dioxide, oxidants, and fluorine compounds are discussed in relation to plant damage, measurement methods, and synergism of SO2 and oxidants. Plant damage can be classified as chronic (invisible) and acute (visible). The main symptoms of plant damages are described. Plant indicators must be chosen by their specific susceptibilities to air pollution.

62275

Heagle, Allen S.

INTERACTIONS BETWEEN AIR POLLUTANTS AND PLANT PARASITES. Ann. Rev. Phytopathol., vol. 11:365-388, 1973. 94 refs.

The sources and effects on vegetation of sulfur dioxide, ozone, and fluorides are reviewed. Various fungus diseases differ in reaction to SO2. Sometimes SO2 decreases parasitism of fungi, which may at first appear to be a positive effect. However since the SO2 affects all forms of plant life, it is generally detrimental. While some fungi are resistant to SO2, SO2 can decrease fungus growth and spore germination. Field observations of the effects of O3 on fungi are rare. Laboratory and greenhouse studies show that O3 can decrease infection, invasion, and sporulation of fungi parasitic on growing plants. Ozone also decreases spore germination. Fluoride effects are minor compared to SO2, but may add to the effects attributed to SO2. There is some evidence these pollutants can affect bacteria, but most evidence concerns human pathogens. Both fluoride and O3 either predispose pinto bean leaves to tobacco mosaic virus infection or somehow increase the ineffectiveness of the virus particles. Trees weakened and injured by SO2 are more likely to be attacked by insects that normally require weakened trees for successful reproduction. But other studies have shown insects to be injured by SO2 and other pollutants. Parasitic disease may affect the development of O3 injury in some cases decreasing O3 injury.

62548

Wallis, W. J., G. W. Miller, M. Psenak, and J. Shieh

FLUORIDE EFFECTS ON CHLOROPHYLL BIOSYNTHESIS IN NICOTIANA TABACUM. Fluoride, 7(2):69-77, April 1974. 30 refs.

The effects of chlorine and fluorine on the biosynthesis of chlorophyll were investigated in Nicotiana tabacum. The effect at different concentrations (0.0001 M, .001, and .01 M) was investigated on the incorporation of 14 Carbon-delta- aminoleuvulic acid (ALA) into coproporphyrin and protoporphyrin fractions, and ether-extractable pigments (chlorophyll a and pheophytin a) in tobacco leaf discs. Both chloride and fluoride at concentrations of .0001 to .01 M inhibited the incorporation of ALA into chlorophyll a and phelophytin a. At 0.01 M the effect of fluoride on AIA incorporation was greater than that of chloride. The inhibition on formation of phelophytin a by fluoride was similar to that found in chlorophyll a, indicating an effect on synthesis of chlorophyll rather than degradation. The effect of fluoride on individual enzymes in the chlorophyll biosynthetic pathway is discussed in relation to the action of fluoride on cellular ultrastructure. (Author summary modified)

62597

Garrec, J. P., J. C. Oberlin, E. Ligeon, A. M. Bisch, and A. Fourcy

FLUORIDE-CALCIUM INTERACTION IN POLLUTED FIR NEEDLES. Fluoride, 7(2):78-84, April 1974. 12 refs.

The fluoride-calcium interaction was investigated in the leaf tissues of fir needles growing in a polluted area. The fluoride and the Ca distribution were established in relation to the effect of fluoride on the chemical forms of Ca. Simultaneous determination of fluoride and Ca by proton microanalysis revealed a simultaneous accumulation in the injured tip, and a large increase in the Ca level throughout the polluted needles. The ratio of the chemical forms of Ca also changes with the accumulation of fluoride; Ca oxalates particularly show an increase. There is a parallel deposition of fluoride and Ca in polluted needles which suggest precipitation of calcium chloride. The largest amounts of Ca and fluoride in equal proportions are localized in the injured area. This localization in the tips suggests a direct relation between the possible precipitation of CaF2 and apical necrosis. The relationship also suggests that formation of CaF2 represents either a mode of inactivation of the halogen or a disturbing factor in the cellular equilibrium of Ca. (Author summary modified)

63167

Garrec, J.-P., E. Ligeon, A. Bontemps, R. Bligny, and A. Fourcy

EXACT LOCALIZATION OF FLUORINE ALONG POLLUTED NEEDLES OF ABIES ALBA BY PROTON MICROANALYSIS. (Localisation exacte du fluor le long d aiguilles polluees d Abies alba par microanalyse au moyen de protons). Text in French. J. Radioanal. Chem., 19(2): 359-365, 1974. 10 refs.

The distribution of fluorine on and near the surface of contaminated needles of Abies alba was studied by proton bombardment, using direct detection of the alpha rays generated during the reaction of F(19) with oxygen. The method is rapid and has a sensitivity of 10 micrograms/g fluorine. Accumulation of fluorine in the necrotic apical zone of the needle in concentrations reaching up to 60,000 micrograms/g, and a slighter degree of accumulation in a narrow zone separation the necrotic from the intact zone of the needle were found. The fluorine concentration in the necrotic apical zone increased rapidly with age, while that in the boundary zone diminished and fell to zero after a certain age. The fluorine concentration was higher in the upper than in the lower surface of the needles.

63442

Gisiger, L.

EXPERIMENTAL STUDY OF FLUORINE DAMAGES IN PLANTS. (Versuche zur experimentellen Abklaerung der Fluorschaeden auf Pflanzen). Text in German. In: Toxicologie

dus Fluors. T. Gordonoff (ed.), Basel/Stuttgart, Verlag Schwabe and Co., 1964, p. 164-178. 4 refs.

The fluorine-inflicted plant damages as occur near aluminum works were studied in pot tests on winter wheat and clover. Plant grown in soil to which sodium and potassium fluorides had been added took up less fluorides, and these fluorides were less soluble than in soils to which the corresponding cryolites had been added. Fluoride doses of up to 180 mg% caused no noticeable loss in yield. Spraying the plants with fluoride solutions resulted in high fluorine contents on the leaves reaching up to 1% without noticeable loss in crops and necrosis. In plants sprayed with fluorides in field tests, damages similar to those occurring in fluorine-polluted areas were observed in rainy weather. Discoloration of the glumes resembling Septoria, and losses in crops occurred in winter wheat sprayed with high concentrations of sodium fluoride solution during the late stages of flowering. Slow increase in the degree of necrosis of the leaf edges in clover smoked with 0.25% hydrofluoric acid by volume for several nights was observed. At the same time, the fluorine content in the leaves increased from a background value of 2.6 mg% to 64 mg% after one treatment, to 104 mg% after two treatments, and to 360 mg% after eight treatments.

63626

Taylor, O. C.

ACUTE RESPONSES OF PLANTS TO AERIAL POLLUTANTS. Advan. Chem. Ser., no. 122:9-20, 1973. 18 refs.

Acute symptoms of injury from various pollutants in different horticultural and agronomic groups are visible on the affected plant. Symptoms include chlorosis, necrosis, abscission of plant parts, and effects on pigment systems. The effects of the following pollutants on plants are described: sulfur dioxide, peroxyacetyl nitrate, fluorides, chlorides, nitrogen dioxide, ozone, and particulates. Minor pollutants causing damage are ethylene, chlorine, ammonia, and hydrogen chloride. Symptoms of acute injury are often used to identify the pollutant source and to estimate agricultural damage. (Author abstract modified)

64166

Daessler, H. G., H. Ranft, and K. H. Rehn

THE SUSCEPTIBILITY OF WOODY PLANTS EXPOSED TO FLUORINE COMPOUNDS AND SO2. (Zur Widerstandsfaehigkeit von Gehoelzen gegenueber Fluorverbindungen und Schwefeldioxid). Text in German. Flora (Jena), 161(3):289-302, 1972. 11 refs.

The susceptibility of 80 woody plant species to fluorine compounds was studied in fumigation chambers and in a test area around a major fluorine emission source, and the results are compared with those of previous sulfur dioxide toxicity tests. The hydrofluoric concentrations in the Chambers ranged from 0.3 to 0.5 mg/cu m. Juglans regia, Vitis vinifera, Pinus silvestris, Berberis vulgaris, Rhododendron japonica, Picea abies, and Larix decidua were the most susceptible species to HF. Taxus baccata, Tilia cordata, Alnus incana, Ribes sanguineum, Salix elaeagnus, Populus regenerata Harff, Carpinus betulus, Pinus Strobus, Pinus nigra austr., Potentilla fruticosa arb., Castanea sativa, Lonicera tatarica, Larix leptolepsis, and Picea pungens were classed as fluorine-susceptible, while such species as Pinus montana, P. contorta, Cornus alba sib., Prunus cerasifera Piss., Ulmus campestre, Alnus glutinosa, Buxus sempervirens, Pinus peuce, Syringa japonica, Acer Negundo, Robinia pseudoacacia, Ailanthus altissima, Fagus silvaticus, Populus candicans, Fraxinus excelsior, Humulus lupulus, Crataegus monogyna, Salix aquatica, Spiraea vonhouttei, Platanus acerifolia, Quercus borealis, Betula pendula, Prunus serotina, Viburnum carlesii, and Hydrangea pan. were moderately susceptible to HF. Juniperus squamata m., Laburnum anagyroides, Viburnum lantana, Tamarix tetr., Spiraea bum. A. Wat., Elaeagnus angustifolia, Weigelia hybr. Ruby, Rosa rugosa, and Syringa vulgaris were relatively resistant. Very high resistance of such species as Acer campestre, Acer platanoides, Evonymus europaea, Philadelphus coronarius, Quercus robur, and Sambucus racemosa was determined. Intercostal necroses, and necroses on the edges and apices of the leaves and needles were the common symptoms of fluorine damage. The overwhelming majority of the species investigated had identical or comparable susceptibility to both fluorine and SO2.

64427

Oelschlaeger, W.

HARMFUL EFFECTS OF FLUORIDE. (Fluorschadenswirkungen). Text in German. Ziegelind. (Wiesbaden), no. 4:169-174, 1974.

Studies and observations on the harmful effects of fluoride emissions from various industrial sources on plants and animals are reviewed. Fluorine, hydrofluoric acid, and other gaseous fluorides are most dangerous to plants, and especially to Conifera. Entering through the stomata such fluorides cause necroses and interfere with metabolic processes. The harmful effects are influenced by such factors as solar radiation, water budget of the soil, relative humidity, and fertilization. Fluorisis in cattle, manifesting itself in bone lesions such as periostal hyperostosis and exostoses, and causing production losses, is due to fluorine present in and on plants ingested. The fluorine tolerance for cattle is proposed to be set at 40 ppm in forage.

64588

Poovaiah, B. W. and H. H. Wiebe

EFFECTS OF GASEOUS HYDROGEN FLUORIDE ON OXIDATIVE ENZYMES OF PELARGONIUM ZONALE LEAVES. Phytopathology, vol. 61:1277-1279, 1971. 7 refs.

Changes in peroxidase and cytochrome oxidase enzymes were established histochemically in hydrogen fluoride fumigated leaves of Pelargonium zonale. Highest peroxidase and cytochrome oxidase activites were localized near the injured areas of fumigated leaves and showed an enhanced benzidine blue coloration in the phloem, with a decreased color or its complete absence in the palisade parenchyma. The enzyme activity was clearly evident in the phloem even after surrounding mesophyll cells had collapsed. Parallel experiments conducted on leaves infiltrated with sodium fluoride solutions showed similar results, though peroxidase activity was inhibited by fluoride levels higher than 0.01 M for 6 hr of bathing. (Author abstract modified)

64758

Matsuoka, Y.

PLANT DAMAGES DUE TO AIR POLLUTION, PART VII: DAMAGES OF AGRICULTURAL CROPS DUE TO HYDROGEN FLUORIDE. (Taiki osen ni yoru shokubutsu higai (7) fukka suiso ni yoru nosakumotsu no higai). Text in Japanese. Nogyo Oyobi Engei (Agr. Hort.), 49(7):1-2, July 1974.

Hydrogen fluoride, silicon tetrafluoride, and other fluorine compounds are toxic to plants. Silicon tetrafluoride converts to HF, causing HF toxic symptoms to plants. Aluminum refineries, steel plants, superphosphate firms, and potteries emit fluorides. Hydrogen fluoride causes long-term damage at

1-5 ppb and acute damage at 10-50 ppb. Rice plants exposed to 50 ppb HF for 48 hr were severely damaged. Rice plants near an aluminum refinery were also damaged. Welsh onions exposed to 30 ppb HF for 6 hr and photographed after 48 hr and red clover exposed to 70 ppb for 11 hr and photographed after 48 hr were also damaged.

64824

Watanabe, Junichiro and Shoji Amano

EFFECTS OF FOLIAR SPRAY OF MINERAL SOLUTIONS ON THE LEAF FALL, RECOVERY FROM FOLIAR CHLORISIS, AND FRUIT SET OF CONTAMINATED SATSUMA MANDARINS GROWN IN THE VICINITY OF AN ALUMINA-REFINING FACTORY. (Arumina seiren kojo kinsetu ondu mikanen ni okeru kakudu enrui yoeki no yomen sanpu go higaiju no rakuyoritsu ka no kaifuku narabi ni kekkaritsu ni oyobosu eikyo). Text in Japanese. Ehime Daigaku Nogakbu Kiyo (Mem. Coll. Agric., Ehime Univ.), 18(1):143-155, Aug. 1973. 12 refs.

Various chemical foliar sprays were tested for their efficacy in reducing fluorine damage to Satsuma mandarin fruit grown in the vicinity of an alumina refining factory. Foliar spray with lime exerted various desirable effects on the persistency of leaves, setting of fruit, titratable acidity of juice, and chlorophyll content of the leaves. Among the mineral elements in the leaves of the sprayed plants, only magnesium showed consistent changes with the application of various sprays.

64860

Bohne, Helmut

EXPLANATION OF A CASE OF FUME DAMAGE IN SCOTCH PINE STANDS IN THE RUHR. (Klarung eines Rauchschadensfalles bei Kieferabestanden im Ruhrgebiet). Text in German. Mitt. Forst. Bundesvers., no. 97:141-150, 1972. (Presented at the International Symposium of Forest Fume Damage Experts, 7th, Essen, West Germany, Sept. 7-11, 1970.)

Sulfur dioxide emitted from coal-burning factories about 4 km to the south and southwest is responsible for the extremely poor appearance and stagnation in the diameter growth of pine stands in the center of the Ruhr. During the growing season, observations of the vegetation were made repeatedly in a wide circle around the works. These revealed trees and bushes which were completely dead or killed off on one side, asymmetrical growth of many plants, color changes in a wide range of plant species, and a progressive reduction in the frequency of these phenomena with increasing distance from the works in all directions. The symptoms of leaf injury were characteristically more pronounced on the side nearer the works, indicating the emission of fluoride compounds from one of the factories. The results of the chemical leaf analyses for sulfur and fluorine confirmed the visual observations with regard to toxic substances and pollution source. Fluorine contents of 24 mg% in leaves and 10 to 14 mg% in the pine needles were found. Measurements of the annual rings showed that diameter increments ceased completely after 1956, which was the year when pollutants were first emitted from the production of fertilizer. The greatest portion of the damage due to acid fumes was caused by pollutants containing fluorine; by comparison, the damage caused by SO2 was of lesser importance.

65103

Lebetseder, J., M. Skalicky, A. H. Said, A. Kment, E. Glawischnig, and G. Schlerka

INVESTIGATIONS OF TOXIC EFFECTS IN CATTLE FROM HAY HARVESTED ON SMOKE-DAMAGED FIELDS. (Untersuchungen über toxische Wirkungen von Heu aus Rauchschadengebieten beim Rind). Ernährung, 2(10):498-502, 1972. 21 refs. Translated from German, 24p.

Clinical investigations of cattle stock feeding on hay harvested from a smoke damaged area near a zinc and lead foundry and a sulfuric acid plant were conducted to investigate whether increased lead, zinc, and fluorine levels in the region produced any toxic effects to the cattle. No signs of poisoning from the above elements were found, with the exception of enamel defects on the incisors of about one-third of the animals examined. Lead and zinc content of the hay was above normal, though still below the toxic limit; while the fluorine content ranged around the upper normal limit. Clinical examinations of blood chemistry, urine, milk, and hair, as well as of the functional capacity of the rumen content at two week intervals showed no signs of poisoning, despite the fact that experimental animals averaged 0.64 l/animal/day less milk yield.

65179

Munshower, Frank F.

BIOTIC MONITORING OF THE EFFECT OF POWER PLANT STACK EMISSIONS ON THE RANGE RESOURCE IN SOUTHEASTERN MONTANA. Preprint, Air Pollution Control Assoc., 14p., 1974. 9 refs. (Presented at the Air Pollution Control Association, Annual Meeting, 67th Denver, Colo., June 9-13, 1974, Paper 74-5.)

Biological monitoring can be used to determine the effects of power plant and other stationary source emissions on the ecosystem. A study was undertaken in southeastern Montana to determine the effect of trace elements (zinc, copper, iron, lead, cadmium), sulfur, and fluoride on the surrounding area. Trace element analyses of soils, plants, and animal were integrated with ecological investigations of the dominant plant communities. Low levels of fluoride occurred in plants and animals. Sulfur levels in plant tissues were 0.1-0.3%. Sulfur concentrations of 0.18% occurred in late summer pasture grasses, decreasing to 0.14% in cured winter grasses. Iron concentrations were normal (50-500 ppm) in all plants examined; concentrations of zinc and copper were below normal; lead and cadmium concentrations were less than 3 ppm and less than 0.3 ppm, respectively, in grasses. Visible sulfur damage occurred only on one pine within 1 mi of the power plant site. This study is the first attempt by a private utility in this area to provide advance warning of environmental degradation in the area surrounding a power plant. (Author abstract modified)

65380

Tennessee Valley Authority, Muscle Shoals, Ala., Technical Library

EFFECTS OF ATMOSPHERIC FLUORIDES ON PLANTS AND ANIMALS (1950- 1974). TVA Bibliography 1061, 11p., 1974. 157 refs.

References are given on papers discussing the effects of fluorides on plants and animals published from 1950 50 1974.

65394

Hindawi, Ibrahim Joseph

INJURY BY SULFUR DIOXIDE, HYDROGEN FLUORIDE, AND CHLORINE AS OBSERVED AND REFLECTED ON VEGETATION IN THE FIELD. J. Air Pollution Control Assoc., 18(5):307-312, May 1968. 24 refs.

Plants were examined at three different locations in the eastern part of the U. S. to determine whether damage from air pollution had occurred. Sulfur dioxide damage occurred in

New York City; hydrogen fluoride occurred near a glass fiber manufacturing plant in the midwest; and hydrochloric acid mist and chlorine damage from a manufacturing operation occurred in an eastern state. The symptoms that developed in the vegetation were often similar. Chemical and microscopical analyses were helpful in diagnosing the toxicants. Pollutant concentrations were measured in the areas studied. Plant damage from SO2 and/or acid mist results from the conversion of SO2 to sulfur trioxide and then to sulfuric acid. The effects of SO2 in the ambient air were more severe than those produced in the laboratory with the same concentration of SO2 because of an additional chemical reaction attributed to ozone in the ambient air. Sulfur dioxide affected leaves, roots, stems, and plant color. The leaves of gladiolus plants, grown downwind of the fluoride source, were damaged by high concentrations of F in the area. Hydrogen chloride and chlorine levels in the eastern state were higher than concentration thresholds causing plant damage. (Author abstract modified)

65558

McCune, D. C., P. J. Temple, and A. M. Witherspoon

ACCEPTABLE LIMITS FOR AIR POLLUTION DOSAGES AND VEGETATION EFFECTS: FLUORIDE. Preprint, Air Pollution Control Assoc., Pittsburgh, Pa., 12p., 1974. 21 refs. (Presented at the Air Pollution Control Association Annual Meeting, 67th, Denver, Colo., June 9-13, 1974, Paper 74-226.)

The relationship between the occurrence of atmospheric fluoride and its effect on vegetation is studied to formulate acceptable limits for air pollution and suggest changes in the design and operation of an emission source. Limiting values for the concentration of hydrogen fluoride range from 10 to 5 ppb for 2- to 4-hour peak concentrations, from 0.6 to 0.3 ppb for mean concentrations of periods of 30 to 60 days, and 4 to 1 ppb for daily mean concentrations depending upon the magnitude of diurnal fluctuations and the degree to which days of greater concentration tend to cluster together. These values are derived from experimental fumigations of plants with HF and there are several criteria for their selection. The risk of an unacceptable effect should be low where this risk depends in part upon the susceptibility, size, and function of the plant populations to be protected. Periods for which the limiting concentrations are selected should consider the effects of both short and long term exposures, temporal variability in atmospheric concentrations, and time-dependent changes in the susceptibility of plants to HF. (Author abstract)

65715

Tsunoda, F., E. Aizawa, and S. Sakurai

STUDIES ON AIR POLLUTION DUE TO FLUORIDES, PART II: ON THE FLUORINE CONTENT OF RICE SEEN FROM THE RESPECTIVE SOURCE OF POLLUTION. (Fukkabutsu ni yoru taiki osen ni kansuru kenkyu -dai 11po- osengen betsu ni mita sanmai chu no fusso ganyuryo ni tsuite). Text in Japanese. Nippon Koshu Eisei Zasshi (Japan. J. Public Health), 20(10 Special Suppl.): 1p., Oct. 1973. (Presented at the Japan Society of Public Health, Annual Meeting, 32nd, Hiroshima, Japan, Oct. 1973, Paper 560.)

The fluorine content of rice specimens obtained in the fields at various distances in various directions from factories which are regarded as thy major source of fluorine pollution in the air was determined. The fluorine content per ppm of dried specimen were as follows: the average was 0.80 + or - 0.18; the averages of specimens in three areas from four aluminum refineries A, B, C, and D, respectively, within 1 km, 1-2 km, and more than 3 km, were 3.96 + or - 1.85, 2.00 + or 1.07 and 0.93 + or - 0.31; the averages of specimens obtained respectively in the field within 1 km, 1-2 km, and more than 3 km of a pottery manufacturing plant, E, were 7.31 + or - 4.87, 1.55 + or - 0.97 and 0.82 + or - 0.1; the averages of specimens obtained in the field at the same distances as above from four phosphate fertilizer factories, F, G, and H were 1.72 + or - 1.13, 1.12 + or - 0.38 and 0.66 + or - 0.03, respectively; and the average contents of fluorine in rice specimens obtained in the field located 1-2 km and more than 3 km from three iron foundries, I, J and K were respectively 0.94 + or - 0.35 and 0.82 + or - 0.18. The fluorine content of rice appeared in decreasing order, at the same distance, from factories E, A, B, C, D, F, G, J, H, I, K. The rice obtained in the fields near the pottery and aluminum refineries was most polluted bu fluorine. A case was found in which the rice harvested in a field within 1 km of an aluminum refinery contained more than 10 ppm of fluorine. The ratio of gaseous fluoride to water soluble fluoride particle in the air around potteries and aluminum refineries is given.

65928

Palm, Einar W.

WHAT AIR POLLUTION DOES TO YOUR PLANTS. Crops Soils Mag., 23(4):14-17, Jan. 1971.

The effects of air pollutants upon plants are summarized. Plants that are sensitive or resistant to sulfur dioxide, fluoride, chloride, nitrogen dioxide, ozone, oxidants, ethylene, and particulates are listed. The damage that smog and other pollutants do to plants often looks like the damage done by diseases, insects, and nutritional imbalances. The various pollutants do not act the same way on each plant. Some pollutants, such as O3, will react differently on different species or even varieties of the same plant species.

66035

Gruender, H. D.

DIFFERENTIAL DIAGNOSIS OF FLUORIDE POISONING IN CATTLE. Fluoride, 7(3):135-142, July 1974. 29 refs. (Presented at the Conference of the I. S. F. R., 5th, April 8-11, 1973.)

The effects of fluoride poisoning on cattle are discussed. Chronic fluoride poisoning in cattle is of great economic significance. It prevails in all parts of the world, mainly because of industrial emissions from metallurgic, ceramic, and chemical industries. Damage due to water high in fluoride or to fluoride present in phosphate rocks and other minerals involves only locally limited regions. The maximum threshold for chronic toxicity ranges 1.2 to 1.5 mg F/kg body weight which corresponds to 50-60 ppm in dry substance for readily soluble fluoride or for contaminated forage. Even lesser amounts in the range of 0.7 to 1.2 mg F/kg body weight can induce dental fluorosis without other toxic manifestations. The minimal acute toxic dose for readily soluble fluoride in cattle lies between 6 and 20 mg/kg body weight/day following oral uptake for several days. These values vary according to conditions of absorption.

66714

Houten, J. G. ten

INFLUENCE OF AIR POLLUTION ON PLANTS. (Invloed van luchtverontreiniging op planten). Text in Dutch. In: Milieubalans van Nederland. J. J. Muickhuyse (ed.), Amsterdam/ Brussels, Intermediair, 1972, p. 47-55. 8 refs.

The effects of air pollutants, such as hydrofluoric acid, sulfur dioxide, nitrogen dioxide, peroxyacetyl nitrate, and ozone on plants are surveyed. While there are substantial species-specific differences in the resistance of plants to air pollutants,

plants are generally more sensitive to them than animals and humans, except for carbon monoxide and hydrogen sulfide. Thus, it is possible to select certain plant species as indicator plants for pollution monitoring. Necrosis of the leaf edges by HF, and interneural necrosis due to SO2 were observed. Once retained, SO2 is readily detoxicated in the leaves by metabolism to sulfates. Peroxyacetyl nitrate and ozone cause zonal necrosis of the leaves probably through the inhibition of the enolase enzyme. Changes in the taxonomic composition of the wild flora in polluted areas were observed.

66715

Tesink, J.

AIR POLLUTION AND ITS EFFECTS ON DOMESTIC ANIMALS. (Verontreiniging van de buitenlucht en gevolgen voor landbouwhuisdieren). Text in Dutch. In: Mileubalans van Nederland. J. J. Mulckhuyse (ed.), Amsterdam/Brussels, Intermedair, 1972, p. 56-75. 29 refs.

The effects of various air pollutants on domestic animals are reviewed. Fluorine compounds, inhaled or mostly ingested in contaminated grass, cause osteoid tissue formation, exostoses, mottled tooth enamel, and anorexia in cattle in chronic exposure. Fluorine content of the milk is negligible, and elimination takes place primarily in the urine. Sulfur dioxide irritates the mucosa, intensifies mucus production, and inactivates the cilia. Nitrogen oxides, apart from being irritating, are noxious for domestic animals primarily via the formation of high nitrate and nitrite levels in grass. Chronic exposure to lead, especially in grass growing along highways, leads to anemia, and to the degeneration of brain and nerve cells. Profuse diarrhea and reduced milk production are caused by ingestion of molybdenum-contaminated grass in cattle. The effects of carbon monoxide are due to the reduction of the oxygen supply by hemoglobin.

66798

Ionescu, A., G. Serbanescu, and G. Pal

ELEMENTS OF THE SYMPTOMATOLOGY OF FLUOR POLLUTED PLANTS. Rev. Roum. Biol. Ser. Bot., 17(2):135-144, 1972. 27 refs.

The toxic effects of fluorine compounds on plants was studied near aluminum and phosphatic fertilizer factories. The general condition of the vegetation in the polluted area, necrosis and foliar and floral discolorations, and sterility in some plant species are discussed. Physiological analyses concerning functional stomata, cellular sap concentration, and biometry were used to explain the fluorine intoxication process. They also constituted an indicative test of the degree of pollution. Symptoms of injury can be used to determine thresholds and tolerance levels for fluoride injuries. (Author abstract modified)

66983

Daessler, Hans-Guenther

THE TOXICITY OF FLUORINE COMPOUNDS. FLUORINE INJURIES IN AGRICULTURE AND FORESTRY. (Zur Toxizitaet von Fluorverbindungen. Fluorschaeden in der Land- und Forstwirtschaft). Text in German. In: Technik und Umweltschutz Luft - Wasser - Boden - Laern., Luftverunreinigung bestimmter Gebiete und technologische Verfahren zur Emissionsvermin'erung. Vol. 5, Leipzig, VEB Deutscher Verlag fuer Grundstoffindustrie, 1974, p. 52-57.

Sources for fluorine containing emissions are hydrofluoric acid plants, aluminum plants, the glass industry, producers of phosphate containing fertilizers, brick kilns, and the ceramic industry. Little attention has been paid in the past to fluorine containing coal whose fluorine content ranges from 2 to 3 mg/kg referred to dry coal. The maximum allowable immission concentration for fluorine in the German Democratic Republic is 10 micrograms/cu m air. A review of the effects of fluorine immissions on agriculture, horticulture, and forestry is given. The fluorine content in plants from immission free areas was determined to range from 0.2 to 2.0 mg/100 g dry substance. Agriculture and forestry strives to reduce fluorine injuries by selecting fluorine resistant species. For this, extensive fumigation experiments in the field and in potted cultures are needed. Exposure to low hydrogen fluoride concentrations and simultaneous measurement of carbon dioxide metabolism supply information on yield reductions and on any possible lowering of the nutrient content. Main emphasis must be placed, however, on reducing the emissions which can be achieved by absorption systems operating with water, diluted caustic soda, and sodium carbonate solution.

67026

Feliciano, Alberto

SURVEY AND ASSESSMENT OF AIR POLLUTION DAMAGE TO VEGETATION IN NEW JERSEY 1971. Rutgers - The State Univ., New Brunswick, N. J., Dept. of Plant Biology, Environmental Protection Agency Contract 68-02-0078, Rept. EPA-R5-72-010, 53p., Oct. 1972. 11 refs. NTIS: PB 214 160

A survey of injury resulting from air pollution episodes and assessment of their resultant effect on crop production in 1971 was conducted in New Jersey. Three hundred fifteen reported air pollution incidences were investigated and documented during the period of the survey which was concentrated in the central and southern counties of the state. Plant injury was observed in 17 counties, but economic loss or crop damage was observed in only 16 of these counties. Over one fourth ($337,265) of the total crop losses ($1,185,800) for New Jersey were recorded in Cumberland County. The photochemical pollutants were responsible for 80% of the plant injury recorded, with ozone contributing about 60% and peroxyacetyl nitrate 20% of the total. The other pollutants involved and their percentages of plant injury are hydrogen chloride mist and chlorine gas 6%, ethylene 3%, fluoride 2%, sulfur dioxide 2%, ammonia 2%, particulates 2%, and oil, petroleum, and an unidentified pollutant 3%. Only 29 out of 70 plant species observed exhibited injury. Vegetables accounted for 51% of the total crop loss. Damage to lettuce accounted for over one third of the vegetable loss and 12% of the total estimated crops. (Author abstract modified)

67056

Linzon, Samuel N.

EFFECTS OF AIR POLLUTANTS ON VEGETATION. In: Introduction to the Scientific Study of Atmospheric Pollution. B. M. McCormac (ed.), Dordrecht, Holland, D. Reidel Publishing, 1971, p. 131-151. 100 refs.

The effects of various air pollutants on vegetation are outlined. Information on symptoms of injury, dosages required to cause injury, sensitivity and tolerance of various plant species, and predisposing environmental and other factors are discussed. Consideration is also given to methods of investigating and preventing the effects of air pollutants on vegetation. The specific pollutants discussed include: sulfur dioxide, oxidants, ozone, O3 and SO2 synergism, peroxyacetyl nitrate, nitrogen oxides, fluorides, chlorine, hydrogen chloride, ethylene, ammonia, mercury, and particulate matter.

67304

Jacobson, Jay S.

THE PLANT-MEDIATED CONSEQUENCES OF AIR POLLUTION. Colorado Univ., Boulder, Air Water Pollut., Proc. Summer Workshop, Boulder, Colo., 1970, p. 417-424, 1972. 14 refs. (Aug. 3-15.)

The effects of air pollution on plants and vegetation are discussed. The most serious threats to vegetation in North America are from photochemical oxidants (ozone and peroxyacetyl nitrate), fluorides, and sulfur dioxide. Injury to plants by other pollutants as ethylene, nitrogen dioxide, chlorine, hydrochloric acid, and particulate matter play a more limited role. Tobacco plants are widely used as a biological indicator of O3 because leaves exhibit flecking when exposed to O3. Parts per billion concentrations of fluoride in air can cause severe damage to sensitive vegetation. Large areas of land are still contaminated by sulfur oxides resulting from pollution from smelters in existence 70 yr ago.

67347

Gilbert, O. L.

THE EFFECT OF AIRBORNE FLUORIDES. In: Air Pollution and Lichens. B. W. Ferry, M. S. Baddeley, and D. L. Hawksworth (eds.), Toronto, Toronto Univ. Press, 1973, Chapt. 9, p. 176-191. 20 refs.

The effects of airborne fluorides on lichens is discussed. The toxicity of fluorides to lichens was established by field studies showing that the lichen flora in the vicinity of isolated point sources is severely impoverished, field transplant experiments, and fumigation experiments. Exposure to 13 ppb for 36, 72, and 108 hr causes chlorotic spots and curled margins; 65 ppb for 12 hr produces similar symptoms. Accumulation occurred during fumigation whether visible damage was produced or not. Fluoride damage is reported from Britain, Canada, France, Norway, and the United States. These studies all find F2 toxic to lichens, but there is no agreement on the order of sensitivity. The degree of shelter can have a major effect on the distribution of damage. There is evidence that species can better tolerate the pollution when growing in eutrophicated conditions. Lichens are useful indicators of the spread of F2 pollution from aluminum smelters.

67348

Nash, T. H., III

THE EFFECT OF AIR POLLUTION ON OTHER PLANTS, PARTICULARLY VASCULAR PLANTS. In: Air Pollution and Lichens. B. W. Ferry, M. S. Baddeley, and D. L. Hawksworth (eds.), Toronto, Toronto Univ. Press, 1973, Chapt. 10, p. 192-223. 201 refs.

The effect of air pollution on vascular plants, mosses, and fungi is reviewed. Specific pollutants include sulfur dioxide, fluorides, ozone, nitrogen oxide, peroxyacetyl nitrate (PAN), and particulates. A mean annual local concentration of SO2 above 0.01-0.08 ppm causes extensive phytotoxic effects in many species. Symptoms of fluoride poisoning vary tremendously between plant groups. Background variations of F2 in plants generally range between 0.5 and 25.0 ppm by weight. The range of 25-105 ppm is the critical range for sensitive species. The most sensitive species are injured by O3 fumigations between 5 and 12 pphm for 2-4 hr, while resistant species tolerate concentrations as high as 100 pphm. Plants respond physiologically to subacute dosages of NOx although higher concentration of NOx than SO2 are required to produce necrotic markings. Damage from PAN can occur at concentrations below 0.1 ppm. The chloroplasts are particularly sensitive. Damage can also occur from ethylene, chlorine, hydrogen chloride, ammonia, and heavy metal particulates as arsenic, copper, lead, zinc, cadmium, iron, nickel, and cobalt. Mosses are approximately as sensitive to air pollution as lichens and are affected by SO2, O3, F2, and some heavy metals. Fungi are also sensitive to SO2 and O3.

67453

Phillips, P. H.

THE EFFECTS OF AIR POLLUTANTS ON FARM ANIMALS. In: Air Pollution Handbook. Magill and Holden (eds.), New York, McGraw Hill, 1956, p. 8-1 to 8-12. 78 refs.

The acute and chronic effects of arsenic, fluorine, and lead on farm animals are reviewed. Symptoms, tolerances, pathological effects, and thresholds are discussed. The use of dusts or sprays of insecticides can cause poisoning of cattle. Fluorine in stack gas can contaminate vegetation; agricultural sprays and dust can also be a source of fluorine compounds. Cattle and sheep are the most susceptible to fluorine toxicosis of all farm animals, with pigs, horses, and poultry next in susceptibility. Lead compounds from industrial sources such as smelters and coal combustion, from dusts and sprays containing lead arsenate, and from automobile exhaust can pollute the environment and cause lead poisoning of animals. Chronic lead poisoning has occurred frequently on horses grazing near smelters, lead mines, and orchards which were sprayed.

67457

Liang, Ta

SEMI-ANNUAL STATUS REPORT OF THE REMOTE SENSING PROGRAM. APPENDIX D. PLANT SENSITIVITY TO ATMOSPHERIC POLLUTION. Cornell Univ., Ithaca, N. Y., Remote Sensing Program, National Aeronautics and Space Administration Grant NGL 33-010-171, 33p., Dec. 27, 1973. 85 refs.

The relative sensitivity of various forms of vegetation to ozone, sulfur dioxide, hydrogen fluoride, nitrogen oxides, peroxyacetyl nitrate, ethylene, 2,4-dichlorophenoxyacetic acid, chlorine, hydrogen chloride, mercury, ammonia, and hydrogen sulfide was compiled. Sensitivity data were incomplete; in certain cases, different sensitivity ratings were encountered and are listed.

67480

Scholl, Gerhard

BIOLOGICAL METHOD FOR THE DETECTION OF FLUORINE COMPOUNDS IN THE AIR. (Ein biologisches Verfahren zum Nachweis von Fluorverbindungen in Immissionen). Text in German. Mitt. Forst. Bundesvers., no. 97:255-269, 1972. 15 refs.

A biological method for the determination of airborne fluorine contamination is described. The method involves culturing certain grasses (Lolium multiflorum and L. perenne) which are relatively insensitive to fluorine compounds for a defined exposure interval in a standardized growth substrate with comparable nutrient and water supplies in the vicinity of a pollution source. The plant samples obtained at the end of the exposure are analyzed for their fluorine content, with the origin and distribution of airborne fluorine compounds being estimated on the basis of the determined fluorine values. The only plants suitable for the method are those which can accumulate the toxic substance in large amounts without the formation of visible external symptoms of damage or growth depression.

68122

Baum, F.

DETERMINATION OF FLUORINE INJURIES ON AN ALLEY OF LINDEN TREES IN THE IMMEDIATE PROXIMITY OF A BRICK KILN NEAR ISMANING BY LEAF ANALYSES AND AERIAL INFRARED PHOTOGRAPHY. (Ermittlung von Fluorschaeden an einer Lindenalle in unmittelbarer Nache einer Ziegelei bei Ismaning durch Blattanalysen und Luftaufnahmen in Falschfarbentechnik). Text in German. Gesundh.-Ingr., 95(9):259-263, 1974. 17 refs. (Presented at the Second Symposium on Branch-spe ific Emissions, Fluorine Emissions by Brick Kilns, Munich, Germany, Feb. 1, 1974.)

Upon discovery of severe leaf injuries in an alley of linden trees near Ismaning (Munich, West Germany), leaf samples were taken from the lower branches of the trees at three different time periods. The samples were dried, ground, and ashed according to the method by Buck (ashing of 5 g dry substance in a nickel vessel at a temperature of 450 to 500 C in a muffle furnace). The fluorine in the ash was determined by the method of Buck and Stratman. A relationship was determined between the fluorine concentration of the leaves and the location of the tree with regard to a brick kiln close to the alley. The severity of lead necrosis not only corresponded to the determined fluorine concentration but also to the gray tone of the infrared photographs. The results led to the initiation of measures for reduction of the fluorine emissions by this brick kiln.

68394

James, H. A.

SURVEY OF ARSENIC AND FLUORINE LEVELS IN VEGETATION IN T. RODEO-CROCKETT AREAS - 1963 - 1964. Preprint, Bay Area Air Pollution Control District, San Francisco, Calif., 11p., April 1965. 2 refs.

Arsenic and fluoride levels in vegetation of the San Francisco Bay area (Rodeo-Crockett areas of Contra Costa County) were determined over the period September 1963 to August 1964 to determine if various industrial sources, particularly a brickworks facility and a lead smelting operation, were contributing to previously observed plant damage. Twelve monthly vegetation samples were taken at six sites in the area; lime-paper strip samples were taken at the same sites plus one additional location. Fluoride in excess of the safe level for beef cattle (50 ppm soluble fluoride) was found in five of 71 pasture grass samples taken during the survey; elevated arsenic levels coincided with the high fluoride levels in the same samples. Grass sample results were generally in agreement with lime paper data for fluoride and arsenic. Seasonal wind data, visual evidence of plant damage and the analytical findings suggested that the major contributing source, both for fluorides and arsenic, was in the Selby area.

68575

Guderian, Robert

EFFECTS OF AIR POLLUTANTS ON PLANTS. (Wirkungen von Luftverunreinigungen auf Pflanzen). Text in German. Umwelt, 1972:206-211, 1972.

The effects of air pollutants on plants are described. Air pollutants, such as sulfur dioxide, hydrofluoric acid, hydrochloric acid, peroxyacetyl nitrate, and ozone may cause acute, chronic, and invisible or physiological damages to plants by deteriorating the growth, yield, and quality. The extent of the damage progresses with increasing pollutant concentration, rather than the length of exposure time. Both SO2 and HF interfere with photosynthesis, and the former metabolizes chlorophyll to pheophytin, while HF interferes with porphyrine synthesis. Both SO2 and HF deplete the water reserve of the plant organism. Inert dust is injurious in keeping light away from the leaves and clogging the stomate, while toxic, water-soluble dust components act directly on the exposed parts. Air pollution reduces the resistance of plants to frost and pests. Due to their response to air pollutants, certain plants can be used as bioindicators of air pollution.

68602

Gardner, Wayne S.

OZONE INJURY TO TOBACCO PLANTS IN SOUTH DAKOTA. Plant Disease Reptr., 57(2):106-110, 1973. 21 refs.

Ozone injury symptoms appeared on Turkish tobacco plants grown in a greenhouse and on Wisconsin 38 tobacco plants grown in field plots at Brookings, South Dakota in 1970. In 1971, ozone injury appeared on greenhouse and field-grown plants of the Bel-W3, Bel-C, and Turkish types. Ozone fleck was most severe in southeast and east-central South Dakota. A decreasing amount of injury was observed in northeast, central, west-central, and southwest South Dakota. The Bel-W3 tobacco showed injury at eight locations, while Turkish, Bel-C, and Bel-B were injured only in the eastern parts of the state. The Bel-W3 was a reliable monitor of air pollution episodes when plants were continuously produced and observed in the greenhouse at Brookings. New injury appeared on newly matured leaves and older leaves as dark gray to black flecks that turned brown to tan to white with age. Periodic ozone occurrences were recorded by new flecks appearing generally on tissue of younger age. Plant indicators for the pollutants peroxyacetyl nitrate, fluoride, and sulfur dioxide showed no injury in South Dakota. (Author abstract modified)

68770

Leibetseder, Josef, Monika Skalicky, Abdul Hakim Said, Alfred Kment, Erich Glawischnig, and Gerd Schlerka

INVESTIGATIONS OF THE TOXIC EFFECTS OF HAY FROM SMOKE DAMAGED AREAS ON CATTLE. (Untersuchungen ueber toxische Wirkungen von Heu aus Rauchschedengebelten beim Rind). Text in German. Erzmetall., 25(10):498-505, Oct. 1972. 21 refs.

The toxic effect of hay contaminated with lead, zinc, and fluorine, collected from smoke damaged areas around a lead and zinc smelter and another sulfuric acid production plant, on the physiological status of cows was studied by clinical observations and during a 6-month feeding test. The lead and zinc contents in the hay were above normal but below the toxic limit, while the fluorine level approached the upper limit of the normal range. Apart from lesions of the enamel of the incisors, detected in about one third of all exposed animals, no symptoms of poisoning were detected. The recurrent clinical examinations performed every two weeks for hematology, alkaline phosphatase, bilirubin, ornthine carbamoyltransferase, and glutamic-oxaloacetic transaminase-revealed no indications of poisoning. The lead and zinc concentrations in blood, plasma, urine, feces, milk, and hairs were below the toxic range, and the fluorine level in the bones ruled out fluorosis. At the same time, the per-capita milk production was significantly reduced by 0.64 l/day.

69162

Farrier, P. M. and D. R. Pullen

SURVEY OF FLUORIDE LEVELS IN THE AREA AROUND THE BLUFF SMELTER. Proc. Pollut. Res. Conf., Wairakei, New Zealand, 1973, p. 341-356. 13 refs. (June 20-21.)

The environmental control monitoring program at the Bluff Aluminum Smelter is discussed as applied to areas adjacent to the smelter. Fluorine effects on wildlife and vegetation are considered, and the background levels of fluorine in the flora, fauna, air, and water of the area are presented. The effect of smelter emissions on these background levels and the care needed when interpreting these results are also discussed. The results showed that extraneous sources of fluorine may influence the fluoride content of biological tissues and that allowance must be made for this factor in interpreting results against established standards. In particular, the effect of topdressing with phosphate fertilizers was discovered. There was also a great variation in the fluoride levels in different species of flora and fauna. Emission of fluorides from the smelter had a small influence on the background levels in some areas, but in no instances were the standard limits to prevent damage to vegetation and livestock exceeded. No change was detected in the atmospheric fluoride levels in areas western and northern from the smelter since the smelter began operations. Levels on the eastern side (downwind) of the plant were greater, but standards are not expected to be exceeded. (Author conclusions modified)

69488

Gilbert, O. L.

LICHENS AND AIR POLLUTION. In: The Lichens. Vernon Ahmadjian and Mason E. Hale (eds.), New York, Academic Press, 1973, Chapt. 13, p. 443-472. 80 refs.

Various aspects of the effects of air pollution on lichens are reviewed including historical aspects, lichen deserts, environmental effects, and use of lichens as biological indicators of air pollution. The area around an industrial area or city may become a lichen desert, since lichens decrease in number in polluted air. Lichen species increase in number and variety with increasing distance away from urban areas. A lack of data makes it impossible to compare lichen deserts on a truly worldwide scale. There are, however, enough studies from Europe and North America to make it clear that in these areas the zoning of epiphytes is outstandingly similar. The most resistant epiphytic foliose lichen in Europe is Hypogymnia physodes, closely followed by Parmelia sulcata and Physcia tenella. On basic substrata, Lecanora dispersa is the most resistant lichen. The effect of industrial point sources of sulfur dioxide on lichens is similar to that of cities, despite the different patterns of fumigation involved. The causes of lichen deserts are described. Two phytotoxicants, sulfur dioxide and fluorine, have been identified as the major pollutants affecting lichens. The field, analytical, and experimental evidence supporting SO2 as the major city influence are reviewed. The effects of SO2 on growth and metabolism are discussed. The effects of individual habitat factors such as shelter, pH, nutrients, water relations, substratum, seral stage, growth form, and systematic position on the toxic effects of SO2 to lichens are discussed.

69596

Guderian, R.

DAMAGES CAUSED BY EMISSIONS FROM CONVENTIONAL POWER PLANTS IN VEGETATION AND FOOD. (Schaeden an Vegetation und Nahrung durch Immissionen aus konventionellen Kraftwerken). Text in German. Strahlenschutz Forsch. Prax., vol. 12:81-97, 1973. 59 refs. (Presented at the Association of German Radiation Protection Physicians and the Association for Radiation and Environmental Research, 12th Conference, Munich and Nueherberg, West Germany, Oct. 8-9, 1971.)

Studies and observations on plant damage caused by gaseous and particulate emissions of thermal power plants are surveyed. Dust emissions from obsolete power plants with no adequate filters affect plants in the immediate vicinity by reducing exposure to sunlight and increasing the local temperature on the leaves the dust settles on. While the damaging effect of dust from modern thermal power plants equipped with efficient filters is negligible, such power plants and industries emit considerable amounts of sulfur dioxide and fluorine, the most harmful compounds for plant life. These gases penetrate into the leaves through the stomata. Sulfur dioxide reduces the phytosynthesis, temporarily stimulates dissimilation, and, when present in higher concentration, dehydrates the plant by destroying the osomotic potential, and metabolizes chlorophyll to pheophytin. Intercoastal necrosis is caused by SO2, while apical and edge necrosis is due mostly to fluorine compounds. The plant damage due to SO2 and fluorine compounds may manifest itself in reduced yield and quality impairment as well as esthetic deterioration. Fluorine, readily accmulating in leaves, is hazardous for animals and humans ingesting fluorine-contaminated plant materials. The extent of SO2-afflicted damage increases progressively with increasing concentration, and can not be characterized by the product of concentration and exposure time.

69800

Jones, L. H. P. and D. W. Cowling

EFFECTS OF AIR POLLUTION ON PLANTS. Preprint, National Society for Clean Air, Brighton (England), Part 1, p. 1-13, Part 2, p. 71-79, 1972. 59 refs. (Presented at the National Society for Clean Air, Annual Conference, 39th, Scarborough, England, Oct. 16-20, 1972.)

The effects of air pollution on plants are reviewed. Certain features of plants which affect their susceptibility to pollutants are discussed including stomata, leaves and photosynthesis. Pollutants, environmental factors, and specific pollutants (sulfur dioxide, fluorides, smoke, soot, dust, photochemical smog, and oxidant), and plants as indicators of air pollution are reviewed. The paper is then discussed.

69966

Daessler, H. -G., H. Ranft, and K. -H. Rehn

THE SUSCEPTIBILITY OF WOODY PLANTS EXPOSED TO FLUORINE COMPOUNDS AND SO2. (Zur Widerstandsfaehigkeit von Gehoelzen gegenueber Fluorverbindungen und Schwefeldioxid). Text in German. Flora (Jena), vol. 161:289-302, 1972. 11 refs.

The results of fume hardiness tests carried out with several woody plant species in cabin trials and in field tests around a major fluorine emission source with regard to resistance against sulfur dioxide and fluorine compounds are presented. Most of the woody plants were found to respond to both pollutants in a a similar way regarding leaf damage and both the time of occurrence of the first injuries and the extent of the damage. Similarly to SO2-damaged leaves, fluorine-damaged leaves showed apical and edge necroses, while intercostal necroses were prevalent in SO2-exposed leaves. Needles are more sensitive to fluorine than to SO2 in the spring. Juglans regia, Vitis vinifera, Pinus sylvestris, Berberis vulgaris, Picea abies, and Larix decidua were found to be most sensitive to fluorine, while Taxus baccata, Tilia cordata, Alnus incata, Salix elaegnus, Carpinus betulus, Pinus strobus, Pinus nigra austr., Potentilla fruticosa arb., Castanea sativa, Lonicera tatarica, and Picea pungens were less susceptible. Pinus montana, P. contorta, Cornus alba sib., Prunus cerasifera Piss., Ulmus campestre, Alnus glutinosa, Pinus peuce, Robinia pseu-

donacacia, Fagus silvaticus, Fraxinus excelsior, Salix aquatica and fragilis, Malus eleyi, Platanus acerifolia, Quercus borealis, and Prunus serotina were characterized by a medium degree of resistance. Viburnum lantana, Rosa species and cultivars, Syringa vulgaris, and especially Acer platanoides and campestre, Evonymus europaca. Philadelphus coronarius, Quercus robur, and Sambucus racemosa were resistant to fluorine. Castanea sativa, Juglans regia, Rhododendron japonicum Taxus baccata, Vitis vinifera, Buxus sempervirens, Lonicera tatarica, Picea pungens, and Platanus acerifolia were more resistant to fluorine than to SO2, while Lycium halimifolium, Forsythia intermedia, Philadephus coronarius, and Pyracantha coccinea were more susceptible to SO2 than they were to fluorine.

70279

Hiratsuka, N., M. Ito, M. Shinozaki, and M. Mako

EXPERIMENTS ON THE EFFECTS OF AIR POLLUTANTS ON HORTICULTURAL CROPS: PART I. INVESTIGATION OF LOCAL DAMAGE OF HORTICULTURAL CROPS. SEC. A. INVESTIGATION OF THE ACTUAL DAMAGE BY AIR POLLUTION USING INDICATOR PLANTS. (Taiki osen busshitsu ga engei sakumotsu to ni oyobosu eikyo ni kansuru shiken (1) - c. shihyo shokubutsu ni yoru higai jittai chosaho). Text in Japanese. Kanagawa-ken Nogyo Sogo Kenkyujo Gyomu Nenpo (Ann. Rep. Kanagawa Prefect Agri. Integr. Inst.), 1973:74, June 1974.

To see the actual state of the effects of air pollution, indicator plants such as mulberry trees, Satsuma-orange trees, ginkgos, zelkova trees, and pines were chemically analyzed for sulfur, fluorine, and several heavy metals, along with the air pollution data obtained at the monitoring points. The amounts of air pollutants decreased in the order of Ebina, Sagamihara, Aikawa, and Shiroyama cities in Kanagawa Prefecture. Fluorine content of the air was on the average 1.0-1.4 micrograms/day/100 sq cm (filter paper method) and higher in the spring than summer. The sulfur content of mulberry leaves was about 1400 ppm without a local difference, and fluorine content was around 11 ppm, a little higher in the middle part of the Prefecture and in Sagamihara. Sulfur content of Satsuma-orange leaves ranged in 0.1-0.3%, higher in spring than summer; however, no local difference was noticed in sulfur and heavy metal in the leaves. The sulfur content of ginkgo, zelkova, and pine tree leaves was respectively 0.2-0.4, 0.1-0.2, and 0.05-0.15, lower in rural areas than in industrial areas.

70357

Itai, K., F. Tsunoda, and S. Sakurai

ON THE DETERMINATION OF FLUORINE IN BROWN RICE. (Genmai-chu fusso no teiryo-ho ni tsuite). Text in Japanese. Taiki Osen Kenkyu (J. Japan Soc. Air Pollution), 9(2):373, Nov. 1974.

As the air pollution threat due to fluorine has increased, the content of fluorine in crops for food and feed has become important. Previous methods of determining fluorine in rice gave considerable fluctuation. A newly established method of fluorine determination in rice is therefore described. The route of analysis consists of keeping brown rice in calcium hydroxide for 24 hr, then evaporating it to dryness, and calcinating the rice in a crucible at 550 C. The ashes are added to concentrated sulfuric acid with a small amount of silver sulfate and aqua regia and steam-distilled at 137 + or - 5 C. The 10 ml aliquot of 250 ml of distillate was determined for fluoride ion by the fluoride ion meter. Recovery of fluorine was 92-103.2%.

70487

Gordon, C. C.

MOUNT STORM STUDY. Montana Univ., Environmental Studies Lab., Environmental Protection Agency Contract 68-02-0229, 32p., Nov. 17, 1972.

A 3-year study of coniferous foliage damaged by phytotoxic elements, compounds, and particulate matter in the Mt. Storm area of West Virginia and Maryland revealed that the major causal agents are waste products from coal-burning utility plants. The primary pollutant causing damage is sulfur dioxide and its by-product sulfuric acid. The SO2 in the ambient air of the study area causes most of the needle tip necrosis, then progresses to total needle necrosis, and eventually causes premature needle casting. The H2SO4 causes the short-long needle syndrome and much of the reduction in terminal shoot elongation of several coniferous species grown for Christmas tree production. This acid is also responsible for premature needle casting of short needles when basal necrosis becomes severe enough to affect the vascular tissues. Fly ash particulates in the Mt. Storm area contain high concentrations of several elements and compounds, some of which are known to be phytotoxic, such as fluorides and sulfates. Iron, aluminum, and other compounds may or may not affect the trees. Gaseous and particulate fluorides in the area are from the burning of coal. Greenhouse and field studies of white, Scotch, and ponderosa pine seedlings demonstrated that fly ash slurries and hydrofluoric acid will cause two growth abnormalities -- excessive lateral bud production and excessive terminal stem growth. Innoculation of young emerging conifer needles with HF caused the short-long syndrome. Samples collected in six polluted areas in the northwestern U. S. gave further evidence that HF and H2SO4 could cause growth abnormalities. Histological and chemical studies showed the disease syndromes occurring in the Mt. Storm area were identical to those occurring in the northwestern states. It will be impossible to cultivate the three species of conifers under healthy conditions in the Mt. Storm area until adequate abatement equipment is installed at large stationary emission sources of SO2, fluoride, and particulates in the area. (Author summary modified)

70607

Davison, A. W., A. Marsland, and W. E. Betts

A PROPOSED RAPID TEST FOR SUSCEPTIBILITY TO GASEOUS FLUORIDES. Environ. Pollut., 7(4):269-282, Dec. 1974. 11 refs.

A rapid test for determining plant susceptibility to gaseous fluorides is proposed based on the use of cut leaves and fluoride solutions. Mature, nonsenescent leaves of Iris germanica, Ligustrum vulgare, and Poa annua were placed in fluoride solutions of 0, 5, 10, 25, 50, and 100 microgram/ml solutions to establish a standard procedure. The percentage of leaf area showing necrosis was directly related to the fluoride solution concentration, with Poa developing the greatest degree of necrosis and Ligustrum the least. Experiments with barley and maize showed that damage was much greater after 24-hour exposures as compared to 8-hour exposures. Barley, which is relatively resistant to fluoride, required more than 8 hr to show significant damage, suggesting that long exposure may be necessary to cause damage in more resistant species. Experiments with young and mature leaves of Zea mais showed that necrosis was greater in the latter after 48 hr of fluoride treatment. Experiments with compound leaves revealed relatively little damage to lucerne leaves exposed to 100 microgram/ml fluoride, whereas soybean exposed to 50 microgram/ml fluoride exhibited typical water-soaked areas and necrosis. Covering the tips of mature barley leaves with

petroleum jelly before fluoride treatment resulted in a shift of maximum fluoride accumulation from the tip to areas immediately adjacent it. Overall, the percentage of necrosis was slightly reduced. Significant differences to fluoride susceptibility were noted for maize, barley, and wheat; these differences paralleled the susceptibility of the species to atmospheric fluoride. Significant intraspecies, differences in fluoride susceptibility were observed for Zephyr, Sultan, and Julia.

70745

Sakurai, S., K. Itai, and F. Tsunoda

ON THE RELATION BETWEEN AIRBORNE AND FLUORINE IN PLANTS. (Shokubutsu-chu fussoudo to taiki-chu fukkabutsu ni tuite). Text in Japanese. Taiki Osen Kenkyu (J. Japan. Soc. Air Pollution), 9(2):370, Nov. 1974.

A high correlation between atmospheric fluoride and the fluoride content of plants was recognized using several methods. The AP method was used in determining atmospheric content of hydrogen fluoride. The concentrations of hydrogen fluoride; seasonal 1-hour averages highest seasonal values of monthly average values, daily average values, and 1-hour values were examined using the fluoride contents in brown rice and leaves of gladioli. There was a significant correlation between all the atmospheric fluoride values and the fluoride content of brown rice.

70752

Vasiloff, G. N. and M. L. Smith

A PHOTOCOPY TECHNIQUE TO EVALUATE FLUORIDE INJURY ON GLADIOLUS IN ONTARIO. Plant Disease Reptr., 58(12):1091-1094, Dec. 1974. 4 refs.

A photocopy method was used for evaluating and reproducing fluoride-induced leaf injury during a gladiolus indicator plant program. Measurements of leaf injury and fluoride content were made on 5000 leaves from potted gladioli plants grown at 31 indicator plot locations in seven surveillance areas located in the Province of Ontario. Harvested plants were transported to a laboratory where a standard office photocopier was used to make reproductions of four middle-aged leaves from each plant. All leaves collected from each plot were divided into terminal and basal portions for chemical analysis of fluoride and other phytotoxic components. Comparisons of fluoride content and leaf injury for three collections of gladioli in a surveillance area near a fertilizer plant showed reductions in leaf injury which paralleled reductions in fluoride content for increasing distances downwind of the source. As the plot distance increased from 3.4 km to 5.5 km from the source, fluoride content decreased from 5.0 ppm to 3.0 ppm and leaf injury decreased from 4.6% to 0.2%.

70776

Takizawa, H.

LOCAL ENVIRONMENTAL CONTROL AND BIOLOGICAL INDICATOR - AIR POLLUTION AND BIOLOGICAL INDICATOR. (Chiiki no kankyo kanri to seibutsu shihyo - taiki osen to seibutsu shihyo-). Text in Japanese. Kankyo Gijutsu (Environ. Conserv. Eng.), 3(11): 803-812, Nov. 1974.

Two sides of environmental control, the feed forward control and the system of environmental control utilizing feedback, are described with relation to biological indicators. As one of the factors in terrestrial ecological systems, the concentration of air pollutants was related to plant damage, referring to a result of a survey on the frequency of damaged plant (cryptomeria) versus concentration of sulfur dioxide, for several distances from the coast. The merits and the selection standards of a biological indicator are described in detail citing specified plant indicators to respective air pollutants such as SO2, hydrogen fluoride, nitrogen dioxide, ozone, peroxyacetyl nitrate, ethylene, chlorine, hydrogen chloride, ammonia, and photochemical oxidants. As general biological indicators, some insects, some amphibians, fishes, birds, mammals including mankind, and plants, can be used. In utilizing plants as an indicator of air pollution, the detailed standard items which represents the active status of the indicator plants were described.

70984

Pell, Eva J. and Eileen Brennan

ECONOMIC IMPACT OF AIR POLLUTION ON VEGETATION IN NEW JERSEY AND AN INTERPRETATION OF ITS ANNUAL VARIABILITY. Environ. Pollut., 8(1):23-33, Jan. 1975. 33 refs.

The economic impact of air pollution on vegetation in New Jersey was surveyed for the years 1971 and 1972. A loss of $128,019 was sustained in 1972 due to damage of agricultural crops and ornamental plantings exposed to air pollutants. Ozone accounted for 27% of the damage, peroxyacetyl nitrate for 20%, hydrogen fluoride for 18%, ethylene for 15%, sulfur dioxide for 4%, and ammonia for 1%. The loss was only 11% of that estimated for the previous year by a similar method despite the fact that air pollutant concentrations did not decrease from 1971 to 1972 in the agricultural regions during the growing season. An unusual rainfall pattern in 1972 possibly induced a water and/or oxygen stress in the plants such that they were protected from air pollution injury. Other factors such as temperature, humidity, nutrition, the presence of disease, and the use of systemic fungicides may also have enhanced plant resistance to air pollutants. (Author abstract modified)

71078

Shinozaki, M. and T. Hiratsuka

INVESTIGATION OF REAL STATE OF ENVIRONMENTAL POLLUTION BY ANALYSIS OF MULBERRY-LEAVES. (Soyo bunseki ni yoru nokochi no kankyo osen no jittai). Text in Japanese. Taiki Osen Kenkyu (J. Japan. Soc. Air Pollution), 9(2):353, Nov. 1974.

Mulberry tree was chosen as an index plant of air pollution, and the leaves were collected from 20 points in Kanagawa Prefecture in August 1972 and 1973, washed, air-dried, powdered, and analyzed. The average content of heavy metals was 126 ppm of iron, 31 ppm of zinc, 41 ppm of manganese, 8 ppm of lead, 5.3 ppm of copper, 2.6 ppm of nickel and 0.72 ppm of cadmium, without large local difference. The average content of sulfur was 1300-1400 ppm on the average, also without large local differences, however, the content of fluorine was only 8.6-8.8 ppm in the leaves of places remote from industrial districts as compared to the average of 13-14 ppm. The analytical values of sulfur and fluorine in leaves collected from four representative places (middle and north) showed a decreasing tendency from the middle- to the north parts of the Prefecture; in the north part of the fluorine content in leaves coincided to that in the air.

71098

Yamamoto, T., Y. Hirota, and E. Minakami

ENVIRONMENTAL POLLUTION EVALUATION OF FLUORINE COMPOUNDS BY INDEX PLANTS AND FLUORINE ANALYSIS. (Shihyo shokubutsu niyoru kichu fus-

sekabutsu no kankyo osen hyoka to sono bunsekiho no kento). Text in Japanese. Preprint, p. 9-10, 1974. (Presented at the Environmental Toxicology Symposium 1st, Osaka, Japan, Nov. 21-22, 1974, Paper 9.)

The atmospheric pollution pattern by fluorine compounds was evaluated by index plants over a period of 8 yr. The growth and appearance of plants were analyzed in reference to F content in plants (on ground and potted), agricultural products, soil, subterranean water, and atmosphere. The sulfuric acid (with addition of sodium silicate)-steam distillation method was most effective for the determination of F in plant samples. The zinc oxide-sodium carbonate fusion method (sample: ZnO:Na2CO3 equal 1:2:3, 600-1000 C) was most effective for soil analysis. The F content in plant samples showed a decreasing trend over the years, and the radium of polluted areas decreased with time, reflecting the control measures taken over the past years. On the other hand, the atmospheric F concentration showed no significant decrease. No significant relationship was found between F content in plant and that in soil and subterranean water.

71931

Bennett, Jesse H. and A. Clyde Hill

ACUTE INHIBITION OF APPARENT PHOTOSYNTHESIS BY PHYTOTOXIC AIR POLLUTANTS. Am. Chem. Soc. Symp. Ser., no. 3:115-127, 1974. 23 refs.

Plant fumigation experiments in environmental chamber systems were performed to assess the effect of various air pollutants on photosynthesis. Oat, barley, and alfalfa canopies required treatments with more than 1 pphm hydrogen fluoride, about 5 pphm ozone or chlorine, 20 pphm sulfur dioxide, and 40-60 pphm nitrogen dioxide or nitric oxide before apparent photosynthesis rates were measurably depressed after 2 hr of exposure. Plants previously exposed to NO or SO2 recovered much more quickly than plants given HF exposures. Plants treated with Cl2, O3, or NO2 recovered at intermediate rates. Sulfur dioxide-NO2 mixtures induced greater than-additive inhibition of alfalfa apparent photosynthetic rates, with the greatest synergistic effects being observed at low concentrations (15 pphm for each gas). No synergism was evident at 50 pphm of each gas. All other pollutant combinations tested, with the possible exception of SO2 and HF, caused plant responses which are additive in suppressing apparent photosynthesis rates. Ozone or SO2 in combination with NO2 appears capable of measurably suppressing carbon dioxide uptake rates of sensitive plants in concentrations approximating present air quality standards.

72132

Thalenhorst, W.

INVESTIGATIONS ON THE INFLUENCE OF FLUORO CONTAINING AIR POLLUTANTS UPON THE SUSCEPTIBILITY OF SPRUCE PLANTS TO THE ATTACK OF THE GALL APHID SACCHIPHANTES ABIETIS (L.). (Untersuchungen ueber den Einfluss fluorhaltiger Abgase auf die Disposition der Fichte fuer den Befall durch die Gallenlaus Sacchiphantes abietis (L.). Text in German. Z. Pflanzenkrankh. Pflanzenschutz, 81(12):717-727, 1975. 8 refs.

The influence of atmospheric pollutants (especially fluoro compounds) upon the gall density of Sacchiphantes abietis (L.) in young spruce stands has been demonstrated. A histologically visible defense reaction of the cortex tissue in the basis of the buds against the sting of the Pseudofundatriz s stylets is described. Complicated relations were observed between position and distance of the plants to the fluoro pollution focus on the one hand and density and survival rate of the pseudofundatrices and the percentage of defense reactions on the other.

72762

Robbins, M. LeRon, Allan R. Beck, and Jack L. Weigle

DETOXICULTURE AND URBAN AIR POLLUTION. J. Environ. Plann. Pollut. Control, 1(3):46-49, 1973. 19 refs.

The development of plants capable of detoxifying air pollutants is proposed. A scheme is suggested which involves the screening of potential detoxifiers in exposure chambers followed by a breeding program to select the most efficient plants within a species. The establishment of greenbelts around urban areas as well as the utilization of crop plants for pollutant detoxification is also recommended. The use of plants as indicators of dangerous pollution levels is also discussed, with numerous indicator plants being listed for such pollutants as ozone, peroxyacetyl nitrate, sulfur dioxide, and fluorides.

73172

Berge, H.

SULFUR DIOXIDE AND HYDROGEN FLUORIDE EMISSIONS IN REGARD TO PHYTOPATHOLOGY. (SO-2- und HF-Immissionen im Blickpunkt der Phytopathologie). Text in German. Meded. Fac. Landbouwwet., Rijksuniv. Gent, 38(3/2):1545-1548, 1973. 2 refs.

Observations of the effects of sulfur dioxide and hydrogen fluoride on forest trees and their parasites are presented. Abies concolor and Abies veitchi in a smoke damaged area were attacked by Dreyfusia nuesslini most intensely in areas where 2- and 3-year-old needles had already been damaged by SO2 and HF. The attack of Phytomyza ilicis in Ilex was more intense in undamaged specimens than in those exposed acutely to high SO2 concentrations. The spread of Oligonychus ununguis in Picea amorika facilitated the manifestation of SO2-induced damages in yet undamaged 2- and 3-year-old needles. The invasion of areas sheltered from SO2 by Sacchiphantes viridis indicates the susceptibility of this species to SO2. This parasite species did not occur in SO2-damaged areas which were occasionally exposed to sodium fluoride- and arsenic-containing dusts. The considerable damages afflicted by Blastethia turionella to Pinus montana in areas with high SO2 concentrations indicate the high resistance of this species.

73510

Weidensaul, T. Craig

IMPORTANCE OF PLANTS IN OXYGEN PRODUCTION, CARBON DIOXIDE CONSUMPTION, AND AIR PURIFICATION. HortScience, 9(1):8-12, Feb. 1974. 27 refs.

The role of plants in the oxygen-carbon dioxide cycle and their ability to purify the air are discussed. Plants are not necessarily efficient air purifiers, although certain toxic gases can be absorbed by alfalfa. Those most easily absorbed are hydrogen fluoride, sulfur dioxide, and nitrogen dioxide. Carbon monoxide is among the least absorbed of the air pollutants. Ozone, although almost as readily deposited on the surface of plant tissues as HF and SO2, appears to be somewhat less absorbed. Certain woody plants may also be significant in reducing ambient levels of SO2 in the microenvironment immediately surrounding individual leaves; however, most plants which readily absorb SO2 are also the ones most easily injured by it. More research is required for definitive statements to be made about ability of plants to purify the air without suffering significant ill effects.

73518

Keller, T.

THE USE OF PEROXIDASE ACTIVITY FOR MONITORING AND MAPPING AIR POLLUTION AREAS. Eur. J. Forest Pathol., 4(1):11-19, 1974. 18 refs. (Presented at the 2nd International Congress of Plant Pathology, Minneapolis, Minn., Sept. 11, 1973.)

The peroxidase activity of various tree species was used to map zones of plant reaction in areas contaminated with air pollution. Initial experiments in a forest exposed to fluoride emissions from an aluminum smelter for over 20 yr failed because the most sensitive plants were eliminated by selection. However, the use of peroxidase activity to map zones of fluoride contamination in an apricot orchard containing small trees of genetic uniformity was successful. Fluoride concentrations as little as 10 ppm in unwashed foliage were related to increased peroxidase activity, and the enzymes activity largely coincided with the area of visible injury. Increased peroxidase activity in the foliage of white ash was related to oxidant exposure resulting from automotive emissions in an urban area, with the increases being significant even in plants showing no visible injury. Thus, the activity of the enzyme appears to offer a sensitive indication of plant exposure to oxidants and fluorides long before the appearance of plant injury.

74459

Hirose, H., T. Masui, S. Takagi, Y. Seto, M. Iwasaki, S. Ando, and T. Manabe

FLUORINE CONTENT OF ATMOSPHERE AND OF PLANTS AROUND AN ALUMINUM REFINERY. (Alumi-seiren kojo shuhen ni okeru kankyo talki to shokubutsu chu no fussoni tsuite). Text in Japanese. Shikoku Koshueisei Gakkai Zasshi (J. Shikoku Soc. Public Health), 20(1):92-94, Feb. 1975.

Atmospheric fluorine levels at five points located 1 km, 1.5 km, 3 km, 4 km, and 5 km from an aluminum refinery were 22, 14, 20, 12 and 6 micrograms of F/sq m/ mo, respectively, in 1971; 67, 30, 38, 18 and 12 micrograms of F/sq m/mo, respectively, in 1972; and 46, 21, 28, 16, and 12 micrograms of F/ sq m/mo, respectively in 1973. The background fluorine level was 8-15 micrograms/sq m/mo before the refinery was in operation. Fluorine levels in leaves of pine trees at the five points showed increases fron August 1972 to May 1973 of from about 10-15 ppm to 30-55 ppm; however, no increase was observed from Aug 1973 to February 1974. The fluorine content of Artemisia princeps was very large (about 100 ppm) within 1 km of the refinery and became rapidly smaller as the distance from refinery increased, suggesting the usefulness of A.p. as an indicator of fluorine, In spite of the fluorine content, no visible symptoms of fluorine damage were observed in plants around the refinery.

74588

Iwanaga, T.

A PROBLEM OF ENVIRONMENTAL POLLUTION IN RURAL AREAS OF GIFU PREFECTURE. (Gifu-ken noson ni okeru kogai mondai). Text in Japanese. Nihon no Kagakusha (Japan. Sci.), 10(7):329-332, July 1975.

A problem of untimely defoliation of Japanese pear trees in orchards of Kamo City, Gifu Prefecture which occurred in the summer of 1971 was investigated. The damage to leaves began from both the apex and the periphery as discoloration and then proceeded to the central part. The cause of the untimely defoliation was suspected to be fluoride-containing exhaust from a tile factory. Experiments in which pear leaves were exposed to aqueous hydrogen fluoride solution revealed the accumulation of fluorine in pear leaves, and the major cause of the untimely defoliation was thus attributed to fluoride in the exhaust from the tile factory and also to sulfur dioxide.

74617

Bossavy, J.

BEHAVIOR OF THE NATURAL AND CULTIVATED FLORA IN THE PRESENCE OF AIR POLLUTANT REPORT. (Etude du comportement de la flore sauvage ou cultivee a l egard des polluants). Text in French. Centre National d Etudes Techniques et de Recherches Technologiques pour l Agriculture, les Forets, et l Equipement Rural (France), Groupement de Grenoble, Contract 69.01.884, 22p., 1971.

A complex study of the effects of air pollution by fluorine compounds on the vegetation in the Vallee de l Arc, Vallee de la Romanche, and Valleee de la Durance regions in France is presented. Iris, Veratrum, album, Picea excelsa, P. sylvestris, Abies alba, Polygonatum vulgare, Silene inflata, Gentiana lutea, Hypericum species, and Vaccinium myrtillus were the most sensitive species. Coniferous needles which tend to accumulate fluorine were most susceptible to fluorine which caused necrosis, premature loss of needles, and reduced growth. Vast expanses of dead coniferous forests were detected. The fluorine concentrations in the air, determined by means of exposed, calcium hydroxide-impregnated filter paper, ranged from 2.77 to 2.82 g/sq cm/day.

74624

Berry, Charles R.

THE DIFFERENTIAL SENSITIVITY OF EASTERN WHITE PINE TO THREE TYPES OF AIR POLLUTION. Can. J. For. Res., vol. 3:543-547, 1973. 15 refs.

The possibility of selecting clones of eastern white pine with specific sensitivities to different air pollution regimes was investigated. Field screening was carried out by exposing potted seedlings to field conditions for 1 yr or longer in each of three areas where a particular phytotoxicant was known to predominate. The areas were characterized by the following pollution sources and major phytotoxicants: power plant, sulfur dioxide; fertilizer plant, fluorides; and vehicular traffic, oxidants. Selections were made of trees injured during only one season in one area; trees injured during both the summer and winter, but only in one area; trees resistant to air pollution in all three areas; and trees sensitive to air pollution in all three areas. These selections are being propagated for use as specifically sensitive bioindicators of air pollution and as resistant lines for use in seed orchards of white pine. (Author abstract)

74626

Ionescu, A. and T. Moacalu

PLANT YIELDING POTENTIAL IN AREAS WITH POLLUTED ATMOSPHERE. (Potentialul de productie al plantelor in zonele cu atmosfera impurificata. Text in Romanian. Probl. Agric., 25(5):27-35, May 1973. 16 refs.

The effect of air pollution on agricultural yields and methods to prevent crop damage are discussed based on studies conducted in sever zones with heavy air pollution. Fluorine pollution leads to necrosis of wheat, rye, and oat leaves. Corn shows fairly good resistivity. Up to 25% of the plants are affected by air pollution in 41.4% of the cases when they are 500 m from the pollutant source (4.5 ppm fluorine). At 100 m from the source, 80% of the grains are affected; while 42.8% of the plants are affected when located at 500 m from pollutant source. Plants of the Crucifere and Umbelifere species can be

cultivated without significant damage. Based on biometric investigation conducted in the Navodari zone, the wheat height in the non-polluted areas was greater than that of wheat in a polluted zone; the yield in unpolluted areas was also greater for both wheat and oats. Sulfur dioxide and oxidants destroy chlorophyll. Losses can reach 34% in the case of Populus or up to 32% with Onopodon achanthium. The absorption spectrum of chlorophyll is altered by the active substances in pollutant dusts. Plant yields are affected when located at 2000 to 3000 m from the polluting source. Sulfur dioxide from sources located 1 to 3 km away caused a 60% loss in vineyards. Under the same circumstances, corn suffered only a 20% loss in a region where the sulfur dioxide level reached 15 ppm. Organic fertilizers are the most efficient means of blocking the toxic activity of the air pollutants. In air polluted zones, plants such as corn, potato, or castor bean should be cultivated to resist pollutants. Laboratory experiments indicated that Harrach and Triumph more resistant than 301, Bezostala, or Ponca.

74721

Yamamoto, Takeo, Yasunobu Suketa, Eiichi Mikami, and Yoshimi Sato

ENVIRONMENTAL EVALUATION OF AIR POLLUTION BY FLUORIDE UTILIZING PLANT INDICATOR. (Shokubutsu shihyo ni yoru kichu fukkabutsu osen no kankyo hyoka). Text in Japanese. Nihon Nogeikagaku Kaishi (J. Agr. Chem. Soc., Japan), 49(7):347-352, July 1975.

Using leaves of gladiolus gandavensis and Citrus unshu as plant indicators for fluoride in air, the relation between fluoride accumulation in plants and air pollution by fluoride, especially fluoride in the gaseous state, was examined. The relationship between fluoride accumulation and particulate fluoride was also investigated. There was a good correlation between airborne fluoride and fluoride content of the plant leaves. A relationship was also found between the logarithm of fluoride content of leaves and the distance of the plant from the pollutant source. The injury was caused only by particulate fluorides. The average fluoride particle size was about 1.5 micron.

74722

Sukeda, Yasunobu and Takeo Yamamoto

EFFECTS OF ATMOSPHERIC FLUORIDE ON PLANTS. (Shokubutsu ni oyobosu kichu fukkabutsu no eikyo). Text in Japanese. Nihon Nogeikagaku Kaishi (J. Agr. Chem. Soc., Japan), 49(7),341-346, July 1975. 14 refs.

Gladiolus gandavensis, Citrus unshu, Colacasia antiguorum, Cryptomeria japonica, and Oryza sativa were utilized as plant indicators of air pollution by fluoride. There was a correlation between the fluoride content of the leaves of G.g. and C.u., with the correlation coefficient being 0.852 and 0.925, respectively. However, the rate of accumulation of fluoride in G.g. leaves was three times that of C.u. leaves. The content of fluoride in leaves and the visual injury of leaves differed from plant to plant; the fluoride content of C.j. was very high (2180 ppm) with total scorch, while that of C.a. was very low (66 ppm) with severe scorch. The ratio of calcium to silicon in G.g. was 4.38, and that in C.u. was 32.7. The relatively higher tolerance of C.u. to fluoride appeared to be due to the high calcium content and the high ratio of Ca to Si. There was a high correlation between the rice harvest and fluoride content of brown rice, the correlation coefficient being 0.91. When the fluoride content of brown rice exceeded 10 ppm, the harvest was reduced by 2/3 to 1/2 that of controls. Fluoride accumulation in polished rice did not increase by more than 12 ppm.

75027

Suslova, V. V. and V. S. Nikoloyevskiy

EFFECT OF ACID GASES ON THEE PIGMENT COMPOSITION OF THE LEAVES OF TREES AND LAWN PLANTS. (Vliyaniye kislykh gazov na pigmentnyy sostav yev drevesnykh i gazonykh rastenly). Uch. Zap., Perm. Gos. Univ., no. 256:93-132, 1971. 22 refs. Translated from Russian, 44p.

The chlorophyll (I) a and b, carotene (II), lutein (III), violaxanthin (IV), and neoxanthin (V) contents in the leaves of plants which were subjected during various phases of their growth and development to acid gases such as sulfur dioxide, nitrogen dioxide, fluoride, hydrogen fluoride, and phosphoric oxide in various concentrations were studied spectrophotometrically and by paper chromatography. Exposure to the gases caused nonsignificant changes in the pigment content of lawn grasses with different gas resistance. Woody plants revealed an inverse relation between the content of pigments and their gas resistance. The gas- resistant plants contained less pigment and lower Ia/Ib ratios. Differences in the relative distribution of pigments in all plants were nonsignificant. Lawn grasses decreased their pigment content during phases of growth under the influence of acid gases. Pigment system composition in lawn grasses was dependent on SO2 concentration, time of exposure, and species properties. Low concentrations of SO2 during the first day caused pigment decomposition and a decrease of the pigment content on the second day. High concentrations of SO2 stabilized the plant pigments on the first and strongly decomposed them on the second day. Individual and total pigments in nonresistant and medium-gas- resistant woody plants decreased considerably, and increased with an increase of Ia/Ib ratio in the gas-resistant plants. Dependence between the gas resistance and individual and total pigment content in the woody plants was observed. The I and II stabilities in the plants in vitro were low. Statistical calculations revealed a dependence of the xanthophylls and II-IV contents on the gas resistance.

76233

Daly, G. T.

DIAGNOSIS AND ANALYSIS OF AIR POLLUTANT DAMAGE TO PLANTS IN NEW ZEALAND. The Clean Air Society of Australia and New Zealand, Clean Air Conf. 1975 Proc., Rotorua, New Zealand, 1975. p. 684-728. 71 refs. (Feb. 17-21.)

The phytotoxic effects of sulfur dioxide, ozone, gaseous fluorides, photochemical oxidants, nitrogen oxides, and various industrial aerosols are reviewed along with studies in New Zealand involving the use of plants as indicators of air pollution. The distribution of lichen and moss cover on trees, buildings, and soil can be correlated effectively with the pattern of air pollutants at ground level, and the accumulation of pollutants by these plants in an industrial area provides a pollution monitor complementary to that of high volume air sampling or precipitation gauging. Sulfur dioxide and gaseous fluorides (hydrogen fluoride), in particular, exert specific effects on several prominent lichen and moss species. Quantitative examples of field surveys and vegetation sampling in areas exposed to SO2 and fluoride emissions from industrial sources in New Zealand are presented to illustrate how such techniques can be used to help in controlling air pollution. (Author abstract modified)

76297

Kopp, C.

EFFECT OF AIR POLLUTION ON ANIMALS. (Wirkung von Luftverunreinigung auf das Tier). Text in German. Praxis. Pneumol., vol. 28:818-822, 1974. 6 refs.

Animals are exposed to air pollutants, such as fluorine, lead, arsenic, and zinc, primarily through the ingestion of contaminated plants and fodder, while pulmonary uptake is more or less negligible. The pulmonary uptake of fluorine and lead in cattle usually ranges from 1 to 2%. At a daily uptake of 1.2-1.5 g of fluorine in contaminated forage, cows showed yellowish-brown coloration and hypoplasia of the incisors, and slightly disturbed mobility. After 6 years, the fluorine content was 245-890 mg in tail vertebra, and up to 254 mg in teeth, relative to 100 g of ash. The general health status, performance, body weight, and fertility were normal throughout the experiment. Lead emitted by automobiles causes a high degree of contamination of plants near highways, while bushes have an efficient sheltering effect. The concentrations may be normal at distances of 100 to 200 m off the highway. Health damages due to lead in cattle are rated as rather improbable. The determination of the delta-aminolevulinic acid excretion in the urine is suitable for the diagnosis of lead poisoning only conditionally, partly due to the antagonistic effect of zinc.

76451

McCune, D. C.

SUMMARY AND SYNTHESIS OF PLANT TOXICOLOGY. Advan. Chem. Ser., no. 122:48-62, 1973. 29 refs. (Presented at the American Chemical Society, Division of Agricultural and Food Chemistry Meeting, 161st, Los Angeles, Calif., March 31-April 1, 1971.)

A general review of plant toxicology is presented. The effects of air pollution on plants are examined in terms of changes that occur within the plant under experimental conditions and the collating of this information with respect to biological organization, changes in the pollutant, and the effects of environmental factors. Topics discussed include: the genetic background of the plant, the effects of specific pollutants on plant enzymes, patterns of chlorosis and necrosis following pollutant exposure, plant adaptation to pollutants, and synergistic effects of various pollutant combinations. Specific pollutants considered include: sulfur dioxide, ozone, fluorides, peroxyacetyl nitrate, nitrogen oxides, chlorine, sulfur trioxide, and sulfuric acid.

76452

Feder, William A.

CUMULATIVE EFFECTS OF CHRONIC EXPOSURE OF PLANTS TO LOW LEVELS OF AIR POLLUTANTS. Advan. Chem. Ser., no. 122:21-30, 1973. 49 refs. (Presented at the American Chemical Society, Division of Agricultural and Food Chemistry Meeting, 161st, Los Angeles, Calif., March 31-April 1, 1971.)

Studies involving the chronic exposure of green plants to low levels of air pollution are reviewed. The cumulative effects of fluorides, sulfur oxides, ozone, nitrogen oxides, peroxyacetyl nitrate, and photochemical oxidants are considered. Plants exposed to 10 ppm ozone over a long period of time show reduced growth, leaf size, stem length, root weight, and flower production, as well as a delay in the onset of floral initiation. These effects are expressed in terms of the depression of total plant growth or population growth, as distinguished from acute effects which generally cause injury to plants but do not necessarily affect total growth or productivity. Evidence is accumulating which indicates that plants may exhibit depressed growth and yield with or without overt expression of injury symptoms. There appears to be a relationship between the dose- response curves describing acute symptom expression and those which can be used to express suppression of growth and yield. (Author abstract modified)

76715

Honing, Frederick W. and Robert C. Loomis

THE IMPACT OF AIR POLLUTION ON THE FOREST RESOURCE. Preprint, Forest Service, Atlanta, Ga., Environmental Quality Evaluation Group, 13p., 1974 (?). 6 refs.

The effects of air pollutants such as fluorides, sulfur dioxide, and ozone on forest vegetation are reviewed. Fluorides are significant because hydrogen fluoride is toxic to some plants at extremely low concentrations. Fluorides can enter leaves through the stomata and can also be absorbed through the leaf surface. The characteristic symptom of acute fluoride injury on many broad-leaved plant species is necrosis which occurs predominantly at the leaf tips and margins. The characteristic symptom of acute SO2 injury to broad-leaved plants is an inter-veinal necrosis. These areas of dead leaf tissue first have a water-soaked appearance and take on a bleached ivory color in most plant species upon drying. Ozone probably causes more injury to vegetation than any other air pollutant in the United States. In contrast to SO2 and fluoride injury, plant injury due to photochemical oxidants is often found many miles from industrial or urban sources. Ozone injuries are of four general types: pigmented lesions, upper-surface or either-surface bleaching, bifacial necrosis, and chlorosis.

76838

Shinohara, Hisashi, Issei Nakamori, and Kenjiro Takeshita

THE EFFECTS OF AIR POLLUTANTS ON PLANTS. (Taiki osen busshitsu no shokubutsu ni oyobosu eikyo). Text in Japanese. In: Survey and Research Report on Medical Examination Method of Pollution-caused Health Damages, Kyushu Environmental Management Assoc., Fukuoka (Japan), p. 107-110, 1974 (?).

The effects of air pollutants, including sulfur oxides, fluorides, chlorine, and chlorides, on plants are reviewed. Leaves of rice plants develop white spots and gradually lose their green color when exposed to SO2. Leaves of tomato plants develop brown spots although the tomato fruit usually is not injured. The SO2 threshold concentration for rice and wheat plants is about 200 ppm/hr, whereas that for tomato and strawberry plants is 25 ppm/hr. Other plants which are easily injured by SO2 include cotton, lettuce, sweet potato, and carrot. Fluorides cause damage to plants at ppb levels. Plants which are easily injured by fluorides include peach, corn, sweet potato, and grape. Chlorides cause plant damage to a greater extent than does SO2. Radish is injured by chloride concentrations of 1.3 ppm (30 min).

76901

Tsunoda, F., H. Kunida, Y. Sato, K. Sasaki, Y. Kawarada, I. Kimura, M. Murakami, H. Shioi, and T. Yoshida

A CASE OF AUTOPSY OF A BULL REARED UNDER AIR POLLUTION ENVIRONMENT BY FLUORIDE CONDITIONS FOR 30 MONTHS. (Fukkabutsu ni yoru taikiosen-kankyoka no 30 kagetsu shiiku shita ushi no baiken-rei). Text in Japanese. Taiki Osen Kenkyu (J. Japan. Soc. Air Pollution, 7(2):200, Nov. 1972.

A bull with body weight of 530 kg which was reared for 30 mo in a place where the fluorine content of the air is about 1 ppb and the fluorine content of daily plant food is 40-60 ppm was autopsied, the examination just before autopsy showing no anemia and no abnormality being shown in WBC (white blood cells), electrolytes, enzymes, or function of liver and kidney. On pathohistological examination no abnormal finding was obtained on the heart, lung, trachea, brain, liver, kidney, adrenals, spleen, pancreas or lymphatic glands; there were slight hanges on teeth and bone tissue. The fluorine content of

tissues and organs was clearly high only in hard tissues and relatively higher in urine and in serum. The present case was in the stage of chemical fluorosis or the higher stage of bone mottling.

77050

Kumamoto Prefectural Office (Japan)

FLUORINE CONTENT OF PLANTS. (Shokubutsu-chu no fusso ganyuryo chosa). Text in Japanese. In: White Paper on Environmental Pollution in Kumamoto Prefecture in 1974:p. 32-33, 1975.

According to 2-yr survey of the fluorine content of plants done in 1973 and 1974 in Arao City, where air pollution by fluoride from aluminum and phosphate-fertilizer factories exists, the content was larger in 1974 than in 1973, with the exception of rice plants. The values were as follows: 18.8 ppm in 1973 in grapes, 21.6 in Citrus unshu, 16.3 in pears, 18.6 in mulberry trees, and 16.6 in rice plants. In 1974, the figures were, respectively, 20.0, 33.1, 26.8, 22.5, and 12.1 ppm.

77325

Hiratsuka, T. and K. Tohi

INVESTIGATION OF THE INFLUENCE OF AIR POLLUTANTS ON HORTICULTURAL CROPS AND OTHER PLANTS. (Taiki osen busshitsu ga engei sakumotsu to ni oyobosu eikyo shiken). Text in Japanese. Kanagawa-ken Sangyo Senta Shiken Kenkyu Hokoku (Ann. Rep. Kanagawa Prefect. Sericult. Cent.), no. 1:124-139, Aug. 1973.

The degree of air pollution was measured at four monitoring points in the prefecture by dust jar (dust-fall) and alkaline filter paper to determine the monthly total amounts of insoluble matter, soluble matter, sulfur oxides, nitrogen dioxide, and chloride ion. The leaves of mulberry trees were collected at the four monitoring points in May, August, and November, and the sulfur and fluorine contents were determined. In August, leaves were collected from locations within the four monitoring areas and the levels of iron, zinc, lead, copper, cadmium, and nickel were also determined. Morever, an experiment was carried out in a greenhouse where mulberry seedlings were exposed to ozone at 0.2 ppm, and to a mixture of ozone and sulfur dioxide. With some variation, the insoluble matter was larger in August, and generally ranged from 2-5 tons/sq km/30 days. Soluble matter ranged from 1-4 tons/sq km/ 30 days with some variation of area and month. NO2 and SO3 trapped on alkaline filter paper was less than 0.08, 0.02-0.13, 0.01-0.015, and less than 0.15 mg/100 sq cm/day (NO2), and 0.07-0.35, 0.10-0.45, 0.15-0.65, and 0.11-0.35 mg SO3/100 sq cm/ day. Chloride showed relatively small variations. There was little variation of S, F, Zn, Pb, and Cd in the leaves. The exposure experiment on ozone for 12 days (7 hr/day) showed a negative result on the leaves without any symptoms. However, although no damage was observed just after exposure to a mixture of ozone at 0.2 ppm and SO2 at 2 ppm for 4 hr, brown spots appeared between the veins with a little larger sulfur content than the control, after 3-4 days exposure.

77329

Hiratsuka, Tokuyuki, Kazuo Tohi, and Masahiro Ito

INVESTIGATION OF THE EFFECTS OF AIR POLLUTANTS ON CROPS AND PLANTS. (Taiki osen busshitsu ga engei sakumotsu to ni oyobosu eikyo shiken). Text in Japanese. Kanagawa-ken Sangyo Senta Shiken Kenkyu Hokoku (Ann. Rep. Kanagawa Prefect. Sericult. Cent.), no. 2:74-90, July 1974.

An investigation carried out at 19 locations in 4 districts of the Kanagawa Prefecture during 30 dayss in December 1970 is discussed. Dust concentration, including soluble and insoluble substances, was measured with a dust jar. Other pollutants were trapped by alkaline filter paper and determined by barium chlorinilate (SOx), Saltzman (NO2), mercuric chloranilate (Cl ion), and ion electrode (F ion). The sulfur and fluoride contents, as well as the metal contents of mulberry leaves were analyzed in May, August, and November. The average S and F contents in leaves collected in August were 1435 ppm and 11.57 ppm, respectively. Potted mulberry plants were exposed to ozone and sulfur dioxide and O3, at low concentrations for 6 hr a day for 2 days. The S content in leaves exposed only to O3 was the same as that in control leaves, while the leaves exposed to SO2 + O3 contained more S, indicating a synergistic effect of the mixture.

77377

Mankovska, Blanka

INFLUENCE OF FLUORINE IMMISSIONS FROM AN ALUMINIUM FACTORY PLANT ON ITS CONTENT IN DIFFERENT DEVELOPMENTAL STAGES OF EUROPEAN PINE SHOOT MOTH RHYACIONIA BUOLIANA DEN. ET SCHIFF. (LEPIDOPTERA). (Vplyv imisii fluoru z hlinikarne na jeho obsah v roznych vyvojovych stadiach obalovaca mladnikoveno rhyacionia buoliana den. et schiff. (lepidoptera). Text in Czech. Biologia, 30(5):355-360, 1975. 16 refs.

The fluorine content of different developmental stages of the European pine shoot moth Rhyacionia buoliana Den. et Schiff. (Lepidoptera) was examined in relation to fluorine emissions from an aluminum factory in the area. Differences in fluorine content of the moth for control regions versus the region under investigation were statistically significant at the 95% level of significance. The highest fluorine levels were found in dead larvae (465 mg/100 g). Dead pupae showed a level of 152.9-192.5 mg/100 g. Significant fluorine levels were also found in internal parasites, amounting to 68.2-97.6 mg/100 g.

77390

Nakao, M., T. Kimura, and K. Saito

SURVEY OF AIR POLLUTION DUE TO FLUORINE COMPOUNDS, PART II. ON CROP DAMAGE AROUND A TILE FACTORY. (Fusso kagobutsu ni yoru taikiosen ni kansuru chosa, Sono 2, Kawara kojo shuhen ni okeru nosakubutsu higai ni tsuite). Text in Japanese. Shimane-ken Eisei Kogai Kenkyusho Nenpo (Annu. Rep. Shimane Prefect. Inst. Public Health Control Environ. Pollut. Inst.), no. 15, 1974.

Damage to pine trees, fruit trees, and agricultural crops has been reported since 1972. The areas of damage include forests, paddy field, and upland fields. Plant specimens, soil, clay, and glaze materials were analyzed primarily for fluorine. In rice grown near the factory there was a very high fluorine concentration (130 ppm) in the leaves (13 6. ppm in controls), a high fluorine content carrot tops (27.5 ppm), and in the edible part of Welsh onions (68.0 ppm). Samples of clay and glaze materials for tile contained 161-216 and 51-141 ppm of fluorine respectively. Although the fluorine content of clay and glaze material was not high, the plant damage was due to the exhaust gas from the tunnel-type high temperature furnace of the tile maker, which contained about 20.0 mg fluorine/cu m.

77391

Nakano, M., T. Kimura, and K. Saito

SURVEY OF AIR POLLUTION DUE TO FLUORINE COMPOUNDS, PART 1. SILKWORM DAMAGE NEAR AN ELECTRIC STEEL WORKS. (Fussonkagobutsu ni yoru taikiosen ni kansuru chosakenkyu, Sono 1, kinzokukojo shuhen ni okeru

yosan higai ni tsuite). Text in Japanese. Shimane-ken Eisei Kogai Kenkyusho Nenpo (Annu. Rep. Shimane Prefect. Public Health Control Environ. Pollut. Inst.), no. 15, 1974.

The death of silkworms attached to mulberry leaves and the unsuccessful production of cocoons near an electric steel works in Yasugi City, Shimane Prefecture were reported. The damage was due to some substance which adhered to the mulberry leaves in 1972. In 1973, dusts and gases in the works and around it were analyzed for fluorine content. Because of the addition of fluorite to electric furnaces in the reduction stage, the dust contained 1-3% fluorine near the furnace, while gases in the smokeway contained an average of 0.6 mg fluorine/cu m. The amount and fluorine content of dust fall in the mulberry orchard fluctuated between 3.28-9.36 mg/sq m/month (water soluble only) and 5.2-17.5 mg/sq m/month (water soluble).

77421

Aizawa, E.

THE FLUORINE CONTENT OF AIR AND RICE GRAINS IN SEVERAL PARTS OF JAPAN. (Honpo kakuchi ni okeru taikichu fussonodo to sanmai chu fussonodo ni tsuite). Text in Japanese. Iwate Igaku Zasshi (J. Iwate Med. Assoc.), 26(6):655-656, 1975.

The concentration of fluorine was more than 1 microgram/cu m in the area around an aluminum refinery and a pottery factory, 0.1-0.5 microgram in larger cities, 0.1-0.3 microgram in local industrial cities, and undetectable (less than 0.05 microgram) in local commercial cities. In rice grains harvested in areas where the fluorine content of the air was more than 1 microgram/cu m, the fluorine content was significantly higher.

78058

McLaughlin, Samuel B., Jr. and Robert L. Barnes

EFFECTS OF FLUORIDE ON PHOTOSYNTHESIS AND RESPIRATION OF SOME SOUTH-EAST AMERICAN FOREST TREES. Environ. Pollut., 8(2):91-96, Feb. 1975. 14 refs.

The effects of fluoride on the photosynthesis and respiration of detached pine needles and hardwood leaves were investigated. Apparent photosynthesis was commonly depressed when foliage was allowed to take up sodium fluoride solutions ranging from 0.0001 to 0.01 molar concentration. Dark respiration was commonly stimulated at low levels of NaF (0.001-0.0001 M). Higher concentrations of NaF (0.01 M) either stimulated dark respiration (in most hardwoods) or inhibited it (in pines and some hardwoods). Pines were generally more sensitive than hardwoods, and current-year needles were more sensitive than 1-year-old needles. The concurrent stimulation of dark respiration and the inhibition of apparent photosynthesis suggested that growth reduction can occur in trees accumulating low levels of foliar fluoride. (Author abstract modified)

78402

Hawksworth, D. L.

LITERATURE ON AIR POLLUTION AND LICHENS II. Lichenologist, 7(1):62-66, 1975. 56 refs.

An annotated bibliography of 56 references on air pollution and lichens is presented. The topics include: changes in lichen flora in various geographical areas due to air pollution; effect of air pollution on nitrogen fixation in lichens; growth of lichens in areas surrounding sulfur dioxide and fluoride pollutants; effect of air pollution on different lichen species; fumigation experiments with SO2; and use of lichens as air pollution indicators.

78580

Forest Service

AIR POLLUTION DAMAGES: TREES. (SPECIAL REPORT). USFS Rept. 1973, 32p., 1973. 37 refs.

Sulfur dioxide and ozone are probably the most important phytotoxic air pollutants in the northeast. Fluorides, chiefly in the form of the gas hydrogen fluoride, also occur. Injury on conifer needles from all these pollutants is often manifested as necrosis of the needle tip or the entire needle. Ozone also causes a chlorotic mottle of needles. Most pollutants cause more specific symptoms on broadleaved trees. Sulfur dioxide symptoms generally appear on broadleaved trees as an interveinal necrosis, the injured tissue being a light brown. Ozone causes a reddish-purple stipple or brown to white fleck of the upper leaf surface. Fluoride injury is uaually restricted to the margins of the leaf, where toxic accumulations of this pollutant cause the tissues to turn brown and die. Minor pollutants cause a variety of symptoms. The pollutants discussed include ethylene, oxides of nitrogen, ammonia, chlorine, hydrogen chloride, and particulates. Air pollution injury to trees is most prevalent during inversions. Caution should be exercised in the field when diagnosing air pollution injury as it is often confused with injury caused by many other factors. (Author abstract modified)

78681

Imai, S. and S. Sato

ON THE BLACK SPOTS OBSERVED IN THE INTEGUMENT OF SILKWORMS POISONED BY FLUORINE COMPOUNDS. (Kaiko no fusso chudoku ni yoru byohan ni tsuite). Text in Japanese. Preprint, Japan. Society of Air Pollution, Tokyo, (9)2:401, 1974. (Presented at the Japan Society of Air Pollution, Annual Meeting, 15th, Fukushima, Japan, 1974.)

The effect of fluorine compounds on mulberry leaves and silkworms were examined experimentally. Artificial foods containing 0, 10, 20, 40, 80, and 100 ppm of potassium fluoride were fed to fourth instar silkworms. While fluorine-free feed produced normal cocoons, the feed containing even 10 ppm of KF produced lighter and thinner cocoons, and feed containing 20 ppm of KF caused silkworms to die. At more than 80 ppm, all worms died at fourth or fifth instar with brownish black discolorations of the internodal integument, a characteristic symptom of fluorine intoxication. The body weight of the worm did not show any increase. The integument became very fragile; the black spots seen on fifth instar fluorine-intoxicated worms were due to the spotlike bleeding caused by broken integuments.

78956

Mandl, Richard H., Leonard H. Weinstein, and Monica Keveny

EFFECTS OF HYDROGEN FLUORIDE AND SULPHUR DIOXIDE ALONE AND IN COMBINATION ON SEVERAL SPECIES OF PLANTS. Environ. Pollut., 9(2):133-143, Sept. 1975. 26 refs. (Presented at the International Congress of Plant Pathology, 2nd, Minneapolis, Minn., Sept. 4-12, 1973, Paper 4.)

Bean, barley, and sweet corn were exposed separately to charcoal-filtered air, hydrogen fluoride, sulfur dioxide, and a combination of the two pollutants. Plants in two experiments were exposed to 0.006 to 0.0009 ppm HF, to 0.15 or 0.30 ppm SO2, and to the combined pollutants for 7 days. Two other experiments used 0.06 to 0.08 ppm SO2, and exposures were made for 27 days. When high concentrations of SO2 were used, severe injury occurred on corn and barley leaves, and the combination of SO2 and HF did not alter foliar symptom

production. Beans were not injured by any of the treatments. The foliar response of barley and corn was accentuated by the combination of SO2 and HF with lower concentrations of SO2. Symptoms consisted of elliptical lesions on the distal half of older leaves on both of the corn cultivars tested. Foliar accumulation of fluoride was reduced by the combination of SO2 and HF as compared with HF alone. Fresh and dry weight yields of plant tops were not affected. (Author abstract)

79129

Less, L. N., A. M. Arthur, and A. McGregor

FLUORINE UPTAKE BY GRASS FROM ALUMINUM SMELTER FUME. Preprint, American Inst. of Mining Engineers, 21p., 1974. 8 refs. (Presented at the American Institute of Mining Engineers, Annual Meeting, Dallas, Tex., Feb. 1974.)

Perennial ryegrass was grown in controlled atmospheres containing either hydrogen fluoride or submicron particulate fluorides to measure the quantity of fluorine absorbed by the grass under conditions and exposures similar to those occurring near aluminum smelters. The fluorine levels measured in the grass were 100 ppm/l microgram of fluorine as hydrogen fluoride/cu m of air and 1.2 ppm/l microgram of fluorine as fine particulate/cu m of air. These levels were observed for spring and summer conditions with sub-irrigation in the absence of rainfall. Traces (1-2%) of HF were also present in the particulate fluoride atmospheres and perhaps accounted for part or all of the absorption. The uptake of fluorine from submicron particulates thus appears to be less than 1% of that from equal concentrations of fluorine as HF.

79309

Suketa, Yasunobu and Takeo Yamamoto

EFFECT OF ATMOSPHERIC FLUORIDE ON PLANTS (BIOLOGICAL STUDIES ON ENVIRONMENTAL POLLUTION BY FLUORIDE PART I). Text in Japanese. Nippon Nogeikagaku Kaishi (J. Agr. Chem. Soc. Japan), 49(7):341-346, 1975. 14 refs.

The effects of atmospheric fluoride on gladiolus, mandarin, taro, Japan-cedar, and rice were investigated. The sensitivity of these plants against atmospheric fluoride is in decreasing order: taro, gladiolus, Japan-cedar, mandarin. The pool size of fluoride accumulation in plant leaves is in decreasing order: Japan-cedar, mandarin, gladiolus, taro. The calcium contents in the leaves of mandarin and gladiolus are 4.16% and 1.04% respectively. The ratio of calcium/silicon in the leaves of mandarin and gladiolus is 3.27 and 4.38 respectively. The contents of Ca and Si in the leaves of plants affect the sensitivity of plants to atmospheric fluoride. Accumulation of fluorine in unhulled rice is associated with fluorine content in the rice bran, but is not associated with that in the polished rice.

79338

Reinert, Richard A.

POLLUTANT INTERACTIONS AND THEIR EFFECTS ON PLANTS. Environ. Pollut., 9(2):115-116, Sept. 1975. 2 refs. (Presented at the International Congress of Plant Pathology, 2nd, Minneapolis, Minn., Sept. 4-12, 1973, Session 12, Section 2, Paper 1.)

Potentially serious changes occur in plants subjected to mixtures of air pollutants in experimental exposures and ambient air environments. A colloquium on pollutant interactions and their effects on plants was organized for the Second International Congress of Plant Pathology during the autumn of 1974. Three papers were presented at this session, concerning plant growth and development as influenced by combinations of sulfur dioxide and ozone, foliar injury response to combinations of SO2 and nitrogen dioxide, and the response of several plant species to the combination of SO2 and hydrogen fluoride.

79368

Galloway, H. L., R. E. Shoaf, and C. H. Skaggs

A RAPID METHOD FOR THE DETERMINATION OF FLUORIDE IN VEGETATION. Am. Ind. Hyg. Assoc. J., 36(10):721-724, Oct. 1975. 7 refs.

An analytical procedure for the determination of fluoride in vegetation was developed. The method involves leaching the vegetation with a hot solution of strong base and then determining the fluoride in an acidified solution directly with a fluoride selective ion electrode. The average value for 14 determinations is 24.4 micrograms F/g sample. The calculated standard deviation of the method based on these analyses is + or - 1.4 micrograms F/g sample, and the relative standard deviation is + or - 5.8%. This corresponds to a limit of error of 13% at the 95% confidence interval. (Author abstract modified)

79586

Matsumaru, T., M. Morikawa, and Y. Matsuoka

RELATION BETWEEN THE CONCENTRATION OF HYDROGEN FLUORIDE IN AIR AND THE ABSORBANCE OF FLUORINE OF RICE PLANT. (Taikichu fukkasuiso nodo to suito no fusso kyushuritsu to no kankei). Text in Japanese. Taiki Osen Kenkyu (J. Japan. Soc. Air Pollution), 10(4):460, Nov. 1975.

Groups of rice plants (variety koshihikari) grown in pots were exposed at their ear sprouting stage to hydrogen fluoride at average concentrations of 10.1, 22.2, 28.4, 32.8, 37.2, 37.2, 53.1, 71.9, 106.8 and 148.3 ppb for 7 hours (0900-1600) in a growth cabinet under natural light at 30 C and RH of 60%. The content of fluorine was lowest in undeveloped leaves, and highest in the second and third leaves. A linear correlation curve was obtained between the logarithm of the fluorine content of the second leaf (ppm) and the concentration of hydrogen fluoride (ppb) used for exposure, with a correlation coefficient of 0.9185.

79633

Suda, B., H. Shioi, I. Kimura, T. Yoshida, Y. Sato, S. Sakurai, S. Nakaya, K. Itai, Y. Suzuki, Y. Yazaki, and F. Tsunoda

EXPOSURE EXPERIMENTS OF GOATS TO ENVIRONMENTAL POLLUTION DUE TO FLUORIDE IN AIR PART VI. CLINICAL EXAMINATION DATA AND PATHOLOGICAL FINDINGS. (Taikichu fukkabutsu no kankyo osen ni yuru yagi no bakuro jikken Part 6. Rinsyo kensa seiseki oyobi byorishoken). Text in Japanese. Taiki Osen Kenkyu (J. Japan. Soc. Air Pollution), 10(4):480, Nov. 1975.

Results of periodic clinical and histological examination during past 3 years of goats reared in an area around an aluminum refinery where concentration of hydrogen fluoride in air was 0.5-1.0 ppb and fluorine content of pasturage was 30 ppm (four times larger than that in the control area) are given. Although serum fluorine content was apparently higher than in the control group, tests for anemia and hepatic and renal functions showed no difference between experimental and control animals, and abnormal findings in exposed animals which were not seen in the control group were not obtained.

79635

Sakurai, S., K. Itai, S. Nakaya, and F. Tsunoda

STUDIES ON AIR POLLUTION DUE TO FLUORIDES PART 15. ON THE ENVIRONMENTAL POLLUTION DUE TO FLUORIDES AROUND PHOSPHATE FERTILZER FACTORIES. (Fukkabutsu ni yoru taikiosen ni kansuru kenkyu Part 15. Rin-hiryo kojo shuken ni okeru fukkabutsu ni yoru kankyo osen ni tsuite). Text in Japanese. Nippon Koshu Eisei Zasshi (Japan. J. Public Health), 22(10):398, Nov. 1975.

Indicator plants such as iris and pine and agricultural crops such as Welsh onion were collected within a radius of 3 km from a superphoshate factory (A) and a fused phosphatic fertilizer factory (B), and their fluorine contents were determined. The fluorine content of iris was 9.9-78.5 ppm of dried plant, corresponding to a gaseous fluorine content in air of 0.04-0.33 ppm, and 0.15 ppm of soluble particulates around the A factory. The fluorine content of air around the B factory was a little higher than that at the A factory, and although the fluorine content in Welsh onion was 11.2 ppm of dried plant there were plants containing more fluorine, such as iris (93.8 ppm), platanas (295 ppm) and acer (117 ppm). Both factories visibly damaged the plants around them.

79972

Yamazoe, F. and H. Mayumi

STUDIES ON THE METHODS OF IDENTIFICATION OF PLANT DAMAGE DUE TO AIR POLLUTION PART III. DISTRIBUTION AND STATES OF HARMFUL SUBSTANCES IN POLLUTED PLANT BODY. SUBPART 1. SULFUR DIOXIDE. SUBPART 2. HYDROGEN FLUORIDE. (Taikiosen ni yoru shokubutsu higai no kanteiho ni kansuru kenkyu Part III. Osenshokubutsu tainai ni okeru yugai busshitsu no bunpu to keitai). Text in Japanese. Nogyo Gijutsu Kenkyu Hokoku B, no. 27:27-37, Sept. 1975.

Rice plants, two species of salting greens, and soybean plants were exposed to sulfur dioxide at low concentrations, (0.25-0.75ppm) for 5-10 hr/day in the daytime for several days (total hours of exposure between 10 and 54), and the sulfur in the plant body was examined. Several plants, including tomato and Pinus densiflora, were exposed to radioactively labelled sulfur dioxide at 0.5 ppm for 5 hours, and the distribution of radioactive sulfur in the plant body was traced. The same experiments and absorption tests were carried out with hydrogen fluoride, radioactive hydrogen fluoride tracer, and sodium fluoride. The findings are summarized as follows: (1) Sulfur dioxide is absorbed from plant stomata, and the absorbed sulfur exists in a water-soluble state in the plant in decreasing concentrations in leaf-blades, petioles, stems and roots, and especially in large amounts in interveinal parts of the leaves. (2) The intake of sulfur into protein (sulfur-containing amino acids) was less via leaf-absorbed sulfur dioxide than via root-absorbed sulfate ion. Visible damage due to sulfur dioxide is described. The leaf-absorbed hydrogen fluoride was accumulated in the leaf apex and leaf-periphery, especially in leaves with vigorous physiological action. The root-absorbed fluorine translocated into aerial parts, especially into active parts; however, local differences of distribution were not so conspicuous as in the case of leaf-absorption.

79973

Yamazoe, F. and H. Mayumi

STUDIES ON THE METHODS OF IDENTIFICATION OF PLANT DAMAGE DUE TO AIR POLLUTION PART II. ANALYSES AND IDENTIFICATIONS OF HARMFUL SUBSTANCES IN POLLUTED PLANTS. SUBPART 4. DETERMINATION OF FLUORINE BY ION-ELECTRODE METHOD. (Taikiosen ni yoru shokubutsu higai no kanteiho ni kansuru kenkyu, II. Osenshokobutsu chu no yugaiseibun no bunseki kanteiho; 4. Ion-denkyoku ho ni yoru fusso no teiryo). Text in Japanese. Nogyo Gijutsu Kenkyu Hokoku B, no. 27:20-27, Sept. 1975. 20 refs.

In order to examine in detail the ion-electrode method for the determination of fluorine in plants, which is simpler and more rapid than colorimetry, about 45 species of plants collected in polluted areas were analyzed. The ion selectivity of the ion electrode for cyanamide, silicic acid, and carbonic acid gave a positive error of more than 10%. for calcium, iron II, iron III, aluminum, chromium and magnesium there was a negative error of more than 10%. Fluorine should be distilled as fluorosilicic acid at about 140 C, with the addition of silver nitrate to repress the distillation of chlorine. In cases where plants contain more than 5% silica, the calcined ash should be alkali-melted to prevent the hold-up of fluorine by gel-form-silica. The standard solution is best prepared by neutralizing aqueous sodium fluorosilicate with dilute alkaline solution to a pH of 5 - 6, with a detection range of 0.01 - 1000 ppm of fluorine. It is necessary to carefully read the value of potential difference of the electrode at equilibrium. Fluorine in plants can be determined by the ion-electrode method with an accuracy and precision not less than for volumetric analysis with thorium nitrate or colorimetry with alizarin complex.

79974

Yamazoe, F. and H. Mayumi

STUDIES ON THE METHODS OF IDENTIFICATION OF PLANT DAMAGE DUE TO AIR POLLUTION PART II. ANALYSES AND IDENTIFICATION OF HARMFUL SUBSTANCES IN POLLUTED PLANTS SUBPART 3. DETERMINATION OF FLUORINE BY ABSORBANCY WITH THE ALIZARIN COMPLEX REAGENT. (Taiki osen ni yoru shokubutsu higai no kanteiho ni kansuru kenkyu, II. Osenshokubutsu chu no yugaiseibun no bunseki kanteiho; 3. Alizarin complexon shiyaku niyoru fusso no kyukokodo teiryo). Text in Japanese. Nogyo Gijutsu Kenkyu Hokoku B, no. 27:10-20, Sept. 1975. 30 refs.

A method for measuring fluorine in plants, based on absorbancy by alizarin complex reagent is examined. The findings are summarized as follows: (1) In determining fluorine by absorbancy using ALFUSSON, a mixture of alizarin complex-lanthanante-buffer agent, absorption at 620 nm was appropriate. (2) When developing color in a 25 ml measuring flask, the calibration curve showed lineality until 50 microgram (2 ppm) of fluorine during the adding of 3 ml of ALFUSSON solution, making the determination possible. (3) The sensitizing effectiveness of the coexistence of acetone was noticeable; the addition of acetone of 10 ml was appropriate. (4) The absorbancy of the colored solution increases with time; however, it stabilizes after 1.5 hr, and so the determination should be done simultaneously with the standard after 1.5 hours have passed. (5) Because aluminum, iron, and phosphate interfere with the determination, after calcination with milk of lime the plant specimen should be steam distilled in the presence of perchlorate and the distillate should be neutralized with sodium hydroxide. (6) The present method is applicable to low contents, of fluorine. It is more accurate than the volumetric method using thorium nitrate, and especially useful in microdetermination of fluorine in damaged plants.

79976

DIRECTION OF COUNTERMEASURES OF AGRICULTURAL CROPS BY AIR POLLUTION. (Taiki osen ni yoru nosakubutsu higai taisaku no hoko). Text in Japanese. Nogyo oyobi Engei (Agr. Hort.), 50(10):1201-1202, Oct. 1975.

The importance of photochemical smog is emphasized in terms of the number of emergency alerts of photochemical smog in Japan in 1974 (288), and the plant damage occurring at 0.05 - 0.07 ppm of oxidant for 2 - 4 hours. The air pollutants which damage plants are oxidants, sulfur dioxide, nitrogen oxides, hydrocarbons, aromatic compounds, halogen compounds, dusts, smoke, and heavy metals such as cadmium. The economic loss due to plant damage represented by tobacco spot disease (which has a close connection to the concentration of oxidants) was recently estimated as 3 million dollars. The prevention of crop damage due to air pollution is the jurisdiction of the Environment Agency. Environmental standards have already been established for sulfur dioxide, carbon monoxide, floating particulates, nitrogen dioxide, and photochemical oxidant; for hydrocarbons, lead, and fluorine, compounds standards are yet to be established. Methods to protect plants from air pollution, including chemical protectants, have been developed, but no well developed general effort exists.

80064

Sakurai, S.

POLLUTION OF AGRICULTURAL CROPS BY FLUORIDE IN AIR, ESPECIALLY ON BROWN RICE. (Taikichu fukkabutsu ni yoru nosakubutsu osen - tokuni gen-mai ni tsuite). Text in Japanese. Taiki Osen Kenkyu (J. Japan. Soc. Air Pollution), 10(4):231-232, Nov. 1975.

Results of a nation wide determination of the fluorine content of brown rice harvested from fields around fluorine sources are reported. The fluorine content of brown rice harvested in fields without specific fluorine sources ranged from 0.5-1.5 ppm of dried specimen. The fluorine content of brown rice harvested from fields within 1 km of an aluminum refinery ranged from 1 to 8 ppm of dried specimen, according to the wind direction. The accumulation of fluorine in brown rice was highest around aluminum refineries and pottery works, followed by phosphate fertilizer factories. These findings indicate that the amount of fluorine intake from the staple food, rice, is far more than that from inhalation. The fact that the accumulation of fluorine in leaf-vegetables such as Chinese cabbage is higher than in brown rice indicates the necessity for further study.

80067

Yamazoe, F.

EFFECTS OF FLUORIDES ON PLANTS. (Fukkabutsu ni yoru shokubutsu eikyo). Text in Japanese. Taiki Osen Kenkyu (J. Japan. Soc. Air Pollution), 10(4):206-209, Nov. 1975. 7 refs.

Fluorine compounds known to be air pollutants, such as hydrogen fluoride and silicon tetrachloride, are highly poisonous to plants even at ppm - ppb levels. As solid microparticles, acidic sodium fluoride and cryolite cause problems by adhering to plant leaves and absorbing into plant bodies. Plants are classified by their susceptibility to hydrogen fluoride: gladiolus, apricot, buckwheat, turnip and Vaccinium vitis-idaea are most susceptible showing slight injury at less than 5 ppb for 7-9 days; maize, pepper, and dahlia are fairly susceptible, followed by azalea, rose, lilac, and alfalfa, then by oak and tomato. Gladiolus is used as an indicator plant. The exposure factor for one species was known. The symptoms of plants exposed to gaseous fluorine compounds are described in detail at various concentrations. The causal mechanism of the injuries due to fluorine compounds is described in detail, with the method of determining the fluorine content of plant parts.

80079

Yoshida, Y.

EXPERIMENTAL STUDY ON MULBERRY LEAF POISONING BY AIR POLLUTION DUE TO A FACTORY S EXHAUST. (Nihon denshi garasu takatsuki kojo no sansokogai taisakushiken). Text in Japanese. Shiga Pref. Sericultural Exp. Sta. Proc., no. 32:93-97, 1975.

The cause of pollution of mulberry leaves used for silkworm feed was found to be fluorine compounds in the exhaust of the Takatsuki glass factory. Exhaust cleaning apparatus was installed. The worms were studied again. In the spring of 1973 a slight increase of dead worms was seen in some areas around the factory without changes in growth, or the yield and quality of cocoons. In autumn of 1973, although there was no change in worm mortality, the infantile stage was delayed 15 hours and the adult stage accelerated 20 hours. No difference of fluorine concentration was found in leaves of several areas around the factory; in one area of elevated content, the standard of 30 ppm was not exceeded. Silkworm damage due to polluted mulberry leaves probably will not be repeated, provided the cleaning apparatus continues to operate satisfactorily.

80083

Tominaga, Y. and T. Miyamoto

FLUORINE-POLLUTION OF PLANTS. (Shokubutsu no fusso osen ni tsuite). Text in Japanese. Ibaraki-ken Kogai Gijutsu Center Nenpo (Annu. Rept. Environ. Pollut. Res. Center Ibaraki Pref.), no. 7:74-77, 1974.

A survey of the fluorine content of plants and of the environment around a metal processing factory (A) and an aluminum-slug treating factory (B) is described. In the leaves of an indicator plant, gladiolus, the fluorine content was 59 ppm at (A) (compared to 31 ppm in a non-polluted area), with visible damage to the plants. In rice plants planted near factory (B), the fluorine content was 95 ppm with visible damage at the apex and periphery of the leaves (compared to 8 - 8 ppm in rice plants in a non-polluted area). The hydrogen fluoride concentration was below the detection limit of the automatic analyzer; however, the larger fluorine content in plants was probably due to the environmental accumulation of hydrogen fluoride. The fluorine content of the plants decreased with distance from the factory.

80085

Yamamoto, T. and Y. Suketa

ENVIRONMENTAL EVALUATION OF AIR POLLUTION DUE TO FLUORIDE IN THE AIR BY PLANT INDICATORS. (Saikubutsu shihyo ni yoru kucho fukkabutsu osen no kankyo hyoka). Text in Japanese. Preprint, Japan Pharmaceutical Assoc., Tokyo, p. 3-6, 1975. (Presented at the Environment-Polluting Substances and their Toxicology Symposium, 2nd, Gifu, Japan, Oct. 27-28, 1975.)

Hydrogen fluoride is detectable by plant damage even at ppb levels. Hydrogen fluoride in waste gas invades the plant body through the plant stomata and is accumulated as fluorides in concentrations several times those accumulated naturally by the plant root. A large correlation coefficient between the ac-

cumulated fluoride in plant leaves and the distance from the source of fluorides was demonstrated in gladiolus and Citrus unshu. The method of sampling and analyzing fluorides in plant leaves, soil, air, and subterranean water is described.

80189

Gilbert, O. L.

EFFECTS OF AIR POLLUTION ON LANDSCAPE AND LAND-USE AROUND NORWEGIAN ALUMINUM SMELTERS. Environ. Pollut., 8(2):113-121, Feb. 1975. 10 refs.

Investigations around three aluminum smelters in Norway revealed that air pollution emanating from the works was affecting landscape and land-use for a distance of several km. A zonal pattern of damage to the total flora is described in sufficient detail to act as a field guide for the recognition of this type of fume damage. The main reason for believing that the effects described above are caused by air pollution-particularly fluorides-emanating from the aluminum works is that the damage is concentric around the point source and decreases in severity with distance. Furthermore, a careful examination of the total flora revealed that the degree of injury was closely related to the fluoride sensitivity of the species. Widespread damage to lichen communities over approximately the same area in which the more sensitive conifers are affected is reliable confirmatory evidence as these cryptograms are sensitive to air pollution but hardy to extremes of climate. Analysis of plant material collected near the works showed that fluorides were being accumulated to potentially toxic levels in the leaves of damaged plants.

80493

Rhoads, A. F. and E. Brennan

FLUORIDE DAMAGE TO WOODY VEGETATION IN NEW JERSEY IN 1974. Plant Disease Reptr., 59(5):427-429, May 1975. 7 refs.

The impact of air pollution on trees in New Jersey was surveyed. Two incidents of severe damage to woody plants by fluorides emitted from specific industrial sources were observed. Classic fluoride toxicity symptoms were observed on plant species that are generally regarded as sensitive, and also on several species of oak. The symptoms on pine were unusual in that a dark band delimiting the necrotic area on the needle appeared 3-4 wk after the initial injury occurred. Douglas fir and peach trees that were defoliated by the pollutant put out a second flush of growth. Among the species exhibiting extreme resistance to fluoride damage were American holly, white birch, London plane, flowering dogwood, magnolia, mulberry, apple, and Norway maple. (Author abstract modified)

80535

Kay, C. E., P. C. Tourangeau, and C. C. Gordon

INDUSTRIAL FLUOROSIS IN WILD MULE AND WHITETAIL DEER FROM WESTERN MONTANA. Fluoride, 8(4):182-191, Oct. 1975. 24 refs.

The use of bone tissue of mules and whitetail deer as indicators of environmental fluoride pollution was evaluated from 1970-1972 in western Montana. Fluoride in vegetation was markedly higher than in control areas. Because individual deer do not live in precisely the same location every year, the exact consumption of fluoride could not be determined, but bone fluoroassays from deer inhabiting two contaminated areas showed a 5 to 50 fold greater fluoride concentration than for controls. In any particular deer, the level of fluoride was highest in the mandible, followed by the femur and the ribs, with the lowest concentration in the metacarpals or metatarsals. Cancellous, metabolically active bones accumulated more fluoride than dense compact bones. (Author summary modified)

80536

Diouris, M. and M. Penot

EFFECT OF SODIUM FLUORIDE ON THE PHOSPHATE ABSORPTION BY POTATO TUBER TISSUE - INFLUENCE OF CALCIUM. Fluoride, 8(4):208-223, Oct. 1975. 36 refs.

Phosphate uptake by disks of potato tubers aged for 24 hr in 0.5 mM calcium chloride was studied after pretreatment for 15 min in 0.05 M sodium fluoride. The disks aged in the CaCl2 solution showed an increase in phosphate uptake only when they were pretreated with NaF. This phenomenon was no longer observed when the calcium was eliminated by the action of ethylene diamine tetraacetic acid. Absorption of calcium and fluoride by the potato disks was essentially a non-metabolic process. Disks aged in a calcium solution fixed more fluoride then fresh disks, but the subsequent increase in uptake of phosphate was not directly related to the increased fixation of fluoride. The rise in phosphate absorption by disks treated with NaF was not a metabolic process, because it occurred when all experiments were conducted at O C. The increased phosphate uptake was largely localized at the physicochemical level in the membrane.

80575

Manning, William J.

INTERACTIONS BETWEEN AIR POLLUTANTS AND FUNGAL, BACTERIAL AND VIRAL PLANT PATHOGENS. Environ. Pollut., 9(2):87-90, Sept. 1975. 27 refs. (Presented at the International Congress of Plant Pathology, 2nd, Minneapolis, Minn., Sept. 4-12, 1973.)

Interactions between air pollutants and fungal, bacterial, and viral plant pathogens are summarized. Ozone injured plants are more susceptible to invasion by facultative parasitic and facultative saprophytic fungi, whereas obligate parasitism by fungi can be retarded by O3 and O3 injury to host tissues. Sulfur dioxide effects are concentrated near point sources. Sulfur dioxide affects microorganisms directly, but indirect effects on roots and root decay are noted. Hydrogen fluoride accumulates in plant tissues and affects plant and microbial pathogen interactions. Fluoride in bean leaves can increase or decrease tobacco mosaic virus lesions, depending on fluoride concentrations. Cement kiln dust deposits increase incidence of Cercospora leaf spot on sugar beets. Limestone dust deposits stimulate leafspot infections on wild grape and sassafras leaves. Increased numbers of bacteria and fungi are found on leaves with light to moderate dust deposits.

80711

Groth, E., III

AN EVALUATION OF THE POTENTIAL FOR ECOLOGICAL DAMAGE BY CHRONIC LOW-LEVEL ENVIRONMENTAL POLLUTION BY FLUORIDE. Fluoride, 8(4):234-240, Oct. 1975. 74 refs. (Presented at the International Society for Fluoride Research Conference, 6th, Nov. 7-9, 1974.)

The potential for ecological damage by chronic low-level environmental pollution by fluoride was evaluated. A wide range of organisms can accumulate substantial concentrations of fluoride from the air, water, or soil. Estimates of fluoride air pollution range from 120,000 to 155,000 ton/yr for the United States. Except in the immediate vicinity of a source, fluoride levels in air are generally quite low, below 1 ppb. Concentra-

tions below 1 ppb are biologically significant and can occur over widespread areas when pollution is present. These levels of exposure are capable of causing some adverse impact in wildlife species. The effects of fluoride pollution on wildlife organisms are summarized. It is possible that fluoride is transformed by some organisms in the natural environment into far more toxic organic fluorides.

81288

Van Hook, C.

FLUORIDE DISTRIBUTION IN THE SILVERBOW, MONTANA, AREA. Fluoride, 7(4):181-199, Oct. 1974. 45 refs.

The distribution of fluoride in soil and plants from a 16,000-acre area contaminated by a phosphorus extraction facility emitting fluoroapatite dust and hydrogen fluoride was investigated. Mean fluoride concentrations in vegetation ranged from 20 ppm to over 100 ppm. Fluoride concentrations as high as 420 ppm, about 40 times greater than control values, were measured in Rocky Mountain junipers, the most commonly sampled tree in the study area. The pattern of fluoride distribution in juniper was similar to that in forage grasses growing in the area. Although localized high concentrations of fluoride were measured in soil samples near the plant, fluoride pollution of the soil appeared to be less widespread than that of vegetation.

81495

Puck, M. R. and C. W. Sulzbach

RESPONSE OF PLANT FRUITING TO HYDROGEN FLUORIDE FUMIGATION. Atmos. Environ., 10(1):73-81, 1976. 20 refs.

Plants of 10 species representing important crops grown primarily for fruit or seed production were exposed to hydrogen fluoride gas in growth chambers. Soybean produced almost no seeds under continuous exposure to HF at a concentration of 0.64 micrograms fluoride/cu m, whereas cotton showed no apparent effects at 8.0 micrograms fluoride/cu m. Bell pepper, sweet corn, cucumber, pea, grain sorghum, oat, wheat, and barley ranked between soybean and cotton in order of decreasing sensitivity of fruiting to HF exposure. Development of fewer seeds was the most common response of fruiting to HF. Flower development was inhibited on pepper and corn plants. The effects on fruiting were apparently independent of HF injury to plant foliage. (Author abstract modified)

81671

Yamazoe, F.

IDENTIFICATION AND JUDGEMENT OF PLANT DAMAGE DUE TO AIR POLLUTION. (Taikiosen ni yoru shokubutsu higai no kentei). Text in Japanese. Sangyo Kogai (Ind. Public Nuisance), 12(1):27-35, 1976. 7 refs.

Chemical analyses of plants damaged by air pollution, especially by sulfur dioxide and fluorine compounds to which plants are highly susceptible is described. The sulfur combustion method was preferred over gravimetric techniques involving addition of milk of lime. The water-soluble sulfur fraction was higher in plants acutely damaged by ambient sulfur dioxide, and in experimentally exposed plants. The extinction coefficient at 622 nm by the reaction of alizarin complexon reagent and fluorine in the presence of lanthanum ion was used to measure fluorine; the method of ionic electrode was preferred. An example of the analysis of plant damage due to dusts and smoke is given.

81771

Havas, Paavo and Satu Huttunen

THE EFFECT OF AIR POLLUTION ON THE RADIAL GROWTH OF SCOTS PINE (PINUS SYLVESTRIS L.). Biol Conserv., 4(5):361-368, Oct. 1972. 22 refs.

The effect of air pollution on the radial growth of scotch pine trees situated within 1.5 km from a fertilizer plant emitting fluorine compounds and fertilizer dust was investigated. The radial growth of pines began to increase after the plant started functioning in 1952, and the increase was greatest and most regular in trees under 50 yr old. The radial growth of trees over 70 yr old was not affected significantly by fertilizer dust and other growth-promoting substances discharged by the plant. After the plant started using apatite and began emitting fluorine compounds, a decrease in radial growth was observed. The radial growth decline was greatest in trees 50-100 yr old and occurred before any visible symptoms of damage were manifested.

82146

Yamamoto, Takeo, Yasunobu Suketa, Eiichi Mikami, and Yoshimi Sato

ENVIRONMENTAL ESTIMATION OF POLLUTION BY ATMOSPHERIC FLUORIDE USING PLANT INDICATOR. (BIOLOGICAL STUDIES ON ENVIRONMENTAL POLLUTION BY FLUORIDE PART II). Text in Japanese. Nippon Nogeikagaku Kaishi (J. Agr. Chem. Soc. Japan), 49(7):347-352, 1975. 18 refs.

Leaves of gladiolus and mandarin orange were used as plant indicators for air pollution by fluoride. The fluoride accumulations of these leaves were associated with gaseous fluoride concentrations. An equation is proposed for the relationship between accumulation of fluoride in plant leaves and distance from the fluoride-emitting source. Particulate fluoride was also collected for 5 yr. Both physicochemical determinations and biological indicators are necessary for monitoring atmospheric fluoride. Particulate fluoride monitoring must be included. (Author abstract)

82208

Sugai, Ryuichi

PRESENT SITUATION OF FLUORIDE ENVIRONMENTAL POLLUTION. (Fukkabutsu ni yoru kankyo osen no jittai). Text in Japanese. Taiki Osen Kenkyu (J. Japan. Soc. Air Pollution), 10(4):199-205, 1975. (Presented at the National Air Pollution Research Conference, 16th, Niigata, Japan, Nov. 5-7, 1975.)

The Niigata Prefectural Environmental Pollution Research Institute reports the state of air pollution caused by fluorides. An air pollution investigation was conducted in 1969 in the neighborhood of an aluminum refining plant in the Naoetsu littoral industrial belt. This aluminum refining plant started operation in May 1963 and is the main source of fluorides, and the largest single aluminum refining plant in Japan. A few years before the plant was first operated, no significant agricultural damage was seen. Since autumn of 1967 damage to vegetation has been obvious, and has increased in relation to the multi-stage expansion of the plant. Yearly changes of concentration of airborne fluorides, present concentrations, gaseous fluorides and particulate fluorides, and the effects of airborne fluorides on vegetation are discussed.

82435

Chiba Prefectural Government (Japan)

MEASURES FOR PREVENTING PEAR DAMAGE: ICHIHARA AREA: ANALYSIS OF METEOROLOGICAL FACTORS AND INVESTIGATION. (Ichihara-chiku nashi higai boshi taisaku jigyo, kisho kaiseki oyobi chosa). Text in Japanese. Chiba-ken Kogai Kenkyusho Nenpo (Ann. Rep. Chiba Pref. Res. Inst. Environ. Pollut.), no. 4:20-21, 1972.

The damage to flowers and the leaves of pear trees in the flowering period in the Ichihara area on April 11 and 12 was studied. Sulfur oxides, fluorides, and meteorological conditions were investigated by examining the records for April 9-14. Although the weather on the 9th and 12th was bad due to the passing of a trough, the weather on the other days was good. Weather conditions were favorable to air pollution, due to weak winds. Days when the concentration of sulfur oxides was relatively high were the 10th (21 pphm), the 11th (19 pphm), the 13th (17 pphm) the 14th (14 pphm). The concentration of hydrogen fluoride was high on the 12th (0.5 ppb).

82498

Matsui, T., Y. Nishi, and T. Asai

CLASSIFICATION AND DIAGNOSIS OF AIR POLLUTION BY BIOLOGICAL INDICATORS. PART 1. (Seibutsu shihyo ni yoru taikiosen no bunkyu to shindan (1)). Text in Japanese. Kankyojo Kagaku (Environ. Inf. Sci.), 5(1):52-63, 1976.

Comparative studies of several biological indicators in an area having the Ube coastal industrial zone as the apex were conducted. Epiphytes on evergreen broad leaf trees, substances on leaves and the sulfur content of leaves were investigated. The vigor of common trees such as Machilus thunbergii, costanopsis sp, Myrica rubra, Irex rotunda, Pinus thunbergii and Pinus densiflora was studied. The destruction of forests in the area was investigated. Soil respiration was determined. The state of influorescence of Osmanthus fragrans, a sensitive indicator, was investigated for 3 years.

82520

Hiratsuka, T., M. Ito, and K. Tohi

STUDIES CONCERNING THE EFFECTS OF AIR POLLUTANTS ON HORTICULTURAL CROPS. (Taikiosen busshitsu ga engeisakumotsu nado ni oyobosu eikyo shiken). Text in Japanese. Kanagawa-ken Sangyo Senta Shiken Kenkyu Hokoku (Ann. Rep. Kanagawa Prefect. Sericult. Cent.), no. 3:43-59, July 1975.

Damage to mulberry leaves in fields in May, Aug., and Nov. was studied with respect to the concentration of air pollutants such as dust fall, sulfur oxides, nitrogen dioxide, chloride ion and fluorine. Laboratory experiments exposing mulberry seedlings to ozone at 0.15 - 0.02 ppm for 20 hr, to ozone at 0.15 - 0.20 ppm for 20 hr and to sulfur dioxide at 1.4 - 1.6 ppm for 14.5 hr, with subsequeit exposures to sulfur dioxide at 1.4 - 1.6 ppm for 14.5 hr at 30 C (daytime) and 23 C (night) were also conducted. The damage to mulberry leaves, represented by their content of sulfur and fluorine, was not so great as last year, except that the fluorine content was a little higher. The results of exposure experiments were: (1) The visable damage was only observed for exposure for 14.5 hr to sulfur dioxide at 1.4 - 1.6 ppm, in contrast to the presumption that the simultaneous exposure to ozone would show a synergistic effect. (2) In spite of lighter visible damage the leaves, the sulfur content of the damaged leaves was larger than that of the leaves which showed heavier visible damage after exposure to sulfur dioxide at 2 ppm for 11 hr in 1971, suggesting that there is no definite relationship between the visible damage and the sulfur content of the leaves.

83082

Garrec, J. P. and A. M. Lhoste

ELECTRON PROBE MICROANALYSIS OF FLUORINE IN POLLUTED NEEDLE SECTIONS OF ABIES ALBA. Fluoride, 9(1):63-70, Jan. 1976. 15 refs.

The effect of hydrogen fluoride fumigation on secretions of needles of Abies alba was investigated by electron probe microanalysis. The levels of fluoride varied in different tissues. Most fluoride was found in the spongy mesophyll and the palisade tissues as a function of the distance from the cells of entry and the paths of translocation of fluoride. The differential responses of various tissues of a leaf to fumigation with HF depended on the localization of the tissues rather than on a specific response by a particular tissue to fluoride. (Author abstract modified)

83145

Kuribayashi, S.

ENVIRONMENTAL POLLUTION EFFECTS ON SERICULTURE AND ITS COUNTERMEASURES (2). (Yosan ni okeru kogai to sono taisaku (2)). Text in Japanese. Sanshi Kagaku to Gijutsu (Sericultural Sci. Technol.), 10(3):48-49, March 1971.

Symptoms on mulberry leaves due to air pollutants such as sulfur dioxide, hydrogen fluoride, chlorine, smokes, heavy metals in floating dust, pesticides applied by airplanes and exhaust gases and dusts (made by friction of tires on pavement) are described in detail. Sulfur dioxide causes oil-soaked type spots to appear on mature leaves (causing silkworms to lose appetite, become inactive, grow nonuniformly, delay coccooning, and suffer softening disease). Hydrogen fluoride causes browning and curling of the leaves only after 14 hr of 30 ppb, causing silkworm inactivity and death. The extent of damage to mulberry fields by air pollution in 1968 was 147 ha by sulfur dioxide, 33 ha by hydrogen fluoride, 172 ha by cement dust, 189 ha by automobile dust and 1388 ha by pesticides (118 ha by airplane).

83182

Mochida, M. and M. Yoshida

SYMPTOMS OF FLUORINE INTOXICATION ON SILKWORMS, ESPECIALLY THE ABNORMAL ARTHROIDAL MEMBRANE. (Kaiko no fussochudokushojo, tokuni setsukanmaku no ijo to sono seppen kansatsu). Text in Japanese. Japan Soc. Sericulture Annu. Meet., 41st, 1971, p. 24. (April.)

Fluorine on or in mulberry leaves severely damages silkworms. The symptoms of intoxication of silkworms due to fluorine are usually chronic, consisting of irregular growth, loss of appetite and motion, hardness when touched, tension of the arthroidal membrane, spots and streaks on the arthroidal membranes and on the apex of the abdominal appendages, and fragile epidermis. Histologically, although the shape of the corial cells does not change, the cuticular layers degenerate (solidify) from the outer layer, and lose their dyeability, with a strong silver reaction. The degeneration develops into internal tissues in some cases. These changes seem to be due to abnormality in the cuticle secretion function. After bringing silkworms into contact with monofluoroacetoamide for one day, the belt-like spot in the arthroidal membrane appeared more vividly and typically than other symptoms.

83258

Nakao, M. and F. Tanaka

RESULTS OF SURVEY ON THE AIR POLLUTION DUE TO FLUORINE COMPOUNDS PART 3. RESULTS OF THE PREPARED SURVEY OF SERICULTURAL DAMAGE

AROUND A METAL FACTORY. (Fussokagobutsu ni yoru taikiosen ni kansuru chosa kenkyu 3. Futatabi kinzoku kojo shuhen niokeru yosanhigai ni tsuite). Text in Japanese. Shimane Ken Eisei Kenkyusho Nenpo (Ann. Rep. Shimane Prefect. Public Health Inst.), no. 16:66-72, 1975. 10 refs.

Results of a survey on the silkworm damage which occurred in March 1973 and reoccurred in Sept. 1974 in the neighborhood of a factory with electric furnaces in Yasugi City, Shimane Prefecture are described. A high content of fluorine (138.4 ppm in dried matter) was found in the mulberry leaves around the factory. A high content of fluorine (3.5-5.8 mg/cu m) in the exhaust of a calcining furnace used in the manufacture of sponge iron was found. The coincidence of the time of the damage, the high content of fluorine in the mulberry leaves, and the high content of fluorine in the exhaust of the furnace indicated that the cause of the silkworm damage was due to the exhaust of the calcining furnace, containing iron sand which contained 30-960 ppm fluorine.

83721

Hirai, T. and C. Yamaguchi

DEGENERATION OF FLOWER PIGMENTS DUE TO AIR POLLUTANTS. (Taikiosen-busshitsu ni yoru hanairo-shikiso no hensei). Text in Japanese. Kinki Daigaku Kogai Kenkyusho Kenkyu Hokoku (Kinki Univ. Pollut. Res. Inst. Rep.), vol. 3:102-110, Oct. 1975. 4 refs.

Sections of 1 sq cm of flower petals (rose, Chinese bellflower, canna, morning glory, chrysanthemum and sasanqua) were soaked in 0.01 molar aqueous solutions of sodium sulfite, sodium fluoride, and sodium azide for 24 hr at 25 C. The flower pigments were extracted from the intact petals and treated with acidic ethanol and their absorption maxima were determined at 400-600 mn. Paper chromatography was used to separate each pigment, and the components were determined by absorption. Generally, sodium azide caused the most severe damage; the damage showed species specificity. Morning glory was not damaged by sodium azide; canna was not damaged by sodium fluoride; chrysanthemum and sasanqua were not damaged by any of the solutions except sodium azide. Some components of the pigments were damaged by the solutions; some were damaged only by sodium azide. Some pigments in rose petals were very susceptible to the solutions, and some were stable (except for exposure to sodium azide).

83723

Suketa, Yasunobu, Yoshio Masui, Shuji Hayakawa, Yoko Sugeno, and Takeo Yamamoto

EFFECT OF HYDROGEN FLUORIDE GAS ON METABOLISM OF GLADIOLUS, IRIS AND CROCUS. (Gurajiorasu, airisu oyobi kurokkasu no daisha ni oyobosu fukkasuisogasu no eikyo). Text in Japanese. Nippon Nogeikagakku Kaishi (J. Agr. Chem. Soc. Japan), 49(12):647-652, 1975. 17 refs.

Gladiolus gandavensis, Iris hollandica, and Crocus vernus grown by hydroponics were exposed to hydrogen fluoride at 3.1-3.4 microgram of F(-)/cu m for 24 hr/day or 8 hr/day in light or dark, for total exposure times as long as 20 days. The respiratory quotient of leaves of all the plants declined with exposure. Oxygen absorption by leaves of gladiolus increased conspicuously with exposure in the light, but decreased a little with exposure in the dark. The protein content of Gladiolus leaves decreased conspicuously after exposure in the light, but showed no change after exposure in the dark. The activity of acid phosphatase was inhibited by exposure; the degree of inhibition was largest in Gladiolus, followed by Iris, then Crocus. The relative value of acid phophatase activity (Y) yielded a regression curve as a function of the respiratory quotient (X): Y equals 0.897X + 0.003 in the three species of Iridaceae, with a correlation coefficient of 0.983. These facts show the possibility of using acid phosphatase activity as an indicator of fluoride pollution in the air.

83730

Fukuoka Environmental Research Center

RESULTS OF INVESTIGATION ON PLANT DAMAGES DUE TO FLUORINE. (Fusso ni yoru shokubutsu higai kankei chosa). Text in Japanese. Fukuoka-ken Eisei Kogai Senta Nenpo (Ann. Rep. Fukuoka Environ. Res. Center), vol. 1973:34, March 1975.

Rice plant withering occurred around a pritt manufacturing factory in July 1973. The fluorine content of the leaves and of the exhaust in the stack of the factory were determined. Although the fluorine content of the exhaust was 0.26 ppm, less than the emission standard, a considerable accumulation of fluorine was found in the rice leaves (34.7 and 352.0 ppm in the upper and lower part of the rice plant grown in a field 200 m distant from the factory, and 56.7 and 228.0 ppm in rice plants grown in a field 350 m from the factory, as compared to 8.9 and 12.4 ppm in a control rice plant). A higher value of fluorine was found in an auto-recorder near an aluminum factory. A determination of fluorine was carried out in leaves of Firmiana platanifolia, chrysanthemum, and salix grown 1000 m from the factory; however, the amount of fluorine (42.3 - 168 ppm) was not much higher than for a control (10 - 46.8 ppm).

83797

Yamazoe, F.

EFFECTS OF FLUORINE COMPOUNDS AS AIR POLLUTANTS ON PLANTS. (Taikiosen busshitsu to site no fukkabutsu no shokubutsu eno eikyo). Text in Japanese. Rodo no Kagaku (Dig. Sci. Labor), 31(4):22-27, April 1976. 3 refs.

Fluorine compounds as air pollutants are mainly hydrogen fluoride and silicon tetrafluoride, and they are known to be highly toxic to plants at concentrations as low as ppb-pphm levels. The order of toxicity to plants runs HF, silicon tetrafluoride, sodium hydrogen fluoride, sodium fluoride, sodium aluminum fluoride, and calcium fluoride. The susceptibility of plants to hydrogen fluoride was classified into categories: those showing injury after exposure for 7 to 9 days at less than 5, at 5-10, and at more than 15 ppb. The most susceptible plant is gladiolus, which is utilized as an indicator plant for hydrogen fluoride. The Adams s exposure factor (average concentration in ppm multiplied by exposure period in hours) is introduced. The symptoms of fluoride injury were peripheral oily immersion, chlorosis, then browning of the leaves. In severer cases, necrosis appeared. A description is given of the mechanism of fluorine injury; it concerns the translocation of fluoride ions in the plant body. Analytical methods of determining fluorine in plants and measures for reducing the damage due to fluorides are described.

83849

DAMAGE DUE TO AIR POLLUTION AND ITS COUNTERMEASURE PART 2. DAMAGE OF AGRICULTURAL AND FORESTRY CROPS. (Taikiosen ni kakawaru higai to taisaku, 2. Noringyo ni taisuru higai). Text in Japanese. In: Chiba Prefectural Environmental White Paper (1975), p. 335-341, 1975.

Incidents of crop damage due to air pollution in Chiba Prefecture (number due to smog in parentheses) numbered 4(1), 9(7), 12(7), 29(25), 30(17), 13(8) and 7(3), in 1968, 1969, 1970, 1971, 1972, and 1973 and 1974, respectively. The damage has oc-

curred around the Keiyo coastal industrial area since 1965. Cases increased until 1972 due mainly to sulfur dioxide and fluorine acutely affecting pears and paddy rice. Acute damage has been prevented by treating exhausts. However, chronic low-concentration pollution and photochemical smog still damage taro, Welsh onion, and maize. One of the causes of damage to red pine and cryptomeria in these industrial areas is thought to be air pollution. Polyvinyl chloride film covering vinyl greenhouses after dust fall resulted in reduced illumination, and thus growth inhibition and poor warming.

83851

RESULTS OF SURVEY OF PLANT DAMAGE DUE TO FLUORINE. (Fusso ni yoru shokubutsu higai kankei chosa). Text in Japanese. In: Annual Report of the Fukuoka Prefectural Center of Hygiene and Environmental Pollution (1973), p. 34, 1974.

An incident of withering of paddy rice plants in the fields around a frit factory in July 1973 was investigated. The content of fluorine in the leaves of the plants and in the off-gas smoke and dust of the factory was determined. Although the stack content was 0.26 ppm, less than the standard, that in the leaves was as high as 34.7 (upper leaves) to 352 ppm (lower leaves) at 200 m from the factory and 56.7 (upper leaves) to 228.0 ppm (lower leaves) at 350 m from the factory, compared to 8.9 to 12.4 ppm 2000 m from the factory. On another occasion of high fluorine in Nov. 1973 around an aluminum refinery, the fluorine content of the leaves of plants nearby (Firmiano platanifolia, chrysanthemum, and fillow) was determined. Very small positive values were obtained: 42.3-75.6 ppm in F. p. 1000 m from the factory and 45.5 ppm 4000 m from the factory; 168 ppm in crysanthemum 1000 m from the factory and 10 ppm 4000 m from the factory; 46.8 ppm in willow 1000 m from the factory and 39.9 ppm 4000 m from the factory.

83854

Div. of Environmental Sanitation, Shimane Prefectural Office

DAMAGE DUE TO THE SMOKE OF A TILE MANUFACTURING FACTORY AND ITS COUNTERMEASURES. (Miyazaki shoten kawara-kojo no baien ni yoru higai to taisaku). Text in Japanese. In: Environmental Pollution in Shimane Prefecture, p. 219-229, 1973.

The withering of leaves of vegetables and rice plants in fields around a tile manufacturing factory was investigated. A survey was carried out revealing that the damage was due to fluorine in the smoke of the factory. The smoke contained 2.67 N cu m/hr of sulfur oxides, 0.06 g of dust/cu m, and 20.0 mg of fluorine/cu m. The harvested brown rice in the field nearby contained fluorine ranging from 1.0 to 9.0 ppm. Vegetables contained 68.0 ppm in leaves and 4.2 ppm in roots. The raw materials of the tile contained from 51.5 to 216 ppm fluorine.

83856

Div. of Environmental Sanitation, Shimane Prefectural Office

DAMAGE OF SILKWORM IN MASUDA CITY AND ITS COUNTERMEASURE. (Masudashi Hanehara chiku ni okeru sanjihigai to sono taisaku). Text in Japanese. In: Environmental Pollution in Shimane Prefecture, p. 316-318, 1974.

The occurrence of silkworm and mulberry damage in July 1974 in the Hanehara area of Masuda City was investigated. Mulberry leaves and the smoke of a ceramic factory nearby were studied. The fluorine content of mulberry leaves near the factory ranged from 11.7 to 33.3 ppm (dry matter); thus, the damage to silkworms was attributed to fluorine in the smoke of the factories. As a countermeasure, fluorine-removing equipment was put into operation in the factories in Jan. 1975.

83885

Mayumi, Y. and F. Yamazoe

ABSORPTION OF FLUORINE FROM LEAF BLADE AND ROOT, AND DISTRIBUTION OF FLUORINE IN PLANT BODY, STUDIES UTILIZING RADIO-FLUORINE. (18F riyo ni yoru fusso no yomen oyobi keikonteki kyushu to tainaibunpu ni tsuite). Text in Japanese. Japan Soc. Soil Sci. Manure Meet., Osaka, 1972, p. 133. (April.)

Potted tomato and cucumber plants were exposed to hydrogen fluoride containing air for 1 hr. Other plants were root-soaked in an aqueous radioactive sodium fluoride solution for 1 hr. Measurement by autoradiography and scintillation counter revealed that the fluorine absorbed from the leaf blades accumulated in the leaf periphery or the apex. The absorption was active in the photosynthetically active leaves of the plant: the distribution was 9.5% in leaves, 4% in stems, and 0.3% in roots. The fluorine absorbed from roots moved into the roots (43.5%), leaves (28.5%), and stems (28.0%) in the case of tomato, and into the leaves (39.2%), roots (37.3%), and stems (23.5%) in another case. The accumulation of fluorine was largest in the most active leaves.

84048

Yamazoe, Fumio and Hirokazu Mayumi

DIAGNOSTIC TECHNIQUES FOR PLANTS AFFECTED BY AIR POLLUTANTS. Nogyo Gijutsu Kenkyusho Hokoku (B), no. 27:51-53, Sept. 1975.

Characteristic acute leaf damage following exposure to sulfur dioxide at concentrations greater than 0.5 ppm and to ozone at concentrations above 01. ppm is described. Water-soluble sulfur and total sulfur determination methods were studied. Spectrophotometric and ion-specific electrode determination of fluorine were studied. The mechanism of sulfur dioxide and fluorine absorption by plants was studied.

84080

Div. of Environmental Sanitation, Shimane Prefectural Office

DAMAGE DUE TO SOOT AND DUST FROM HITACHI METAL REFINERY AND ITS COUNTERMEASURES. (Hitachi Kinzoku kara no baijin higai to sono taisaku). Text in Japanese. In: Environmental Pollution in Shimane Prefecture, p. 217-219, 1973.

Complaints from sericulture farmers about damage to silkworms due to mulberry leaves polluted by soot and dust exhausted from the Yasugi factory of the Hitachi Metal Co. in March 1973 are discussed. Analysis of soot and dust from the improved facilities showed that in July 1973 sulfur oxides, dust, and fluorine in the exhaust gas decreased to values below the standard. However, the dust-fall in the mulberry field 120 m west of the factory was from 2.47 to 5.29 g/sq m/month. After the improvements, the fluorine content of the mulberry leaves in the field was 10-18 ppm, 12-18 ppm and 13-18 ppm in Aug., Sept. and late Aug., respectively, as compared to 60-71 ppm in July 1973. The percentage of healthy cocoons, and the weight of cocoons in May (spring season) were 52.5-72.0% and 1.9-2.0 g; in the autumn these figures were 90% and 2.0-2.3 g. The improvement of the facilities included dust collectors and bag filters.

84089

Kuribayashi, S.

RELATIONSHIP BETWEEN THE CONCENTRATION OF GASEOUS HYDROGEN FLUORIDE AND OF GASEOUS SULFUR DIOXIDE AND ITS EFFECTS ON MULBERRY LEAVES AND SILKWORMS. (Fukkasuiso gas oyobi aryusan gas no nodo to Kuwa oyobi kaiko ni oyobosu eikyo tono kankei). Text in Japanese. Japan. Soc. Sericulture Annu. Meet., 41st, 1971, p. 36. (April.)

When mulberry trees were exposed to gaseous hydrogen fluoride at 0.2 ppm for about 2 hr or to 0.03 ppm for about 14 hr, visible signs of damage such as browning of the leaves from the apex or periphery or shrinking appeared, at a leaf fluorine content of 120-160 ppm. The silkworms, after continuously eating leaves containing 35-70 ppm of fluorine, showed chronic damage; after eating leaves containing more than 90 ppm of fluorine they showed acute damage. Mulberry trees exposed to gaseous sulfur dioxide at 2 ppm for about 72 hr showed visible damage, such as scattered oily immersion-type spots and contained as much as 8000 pppm sulfur. Silkworms that ate the leaves had chronic damage.

84290

Prinz, Bernhard and Robert Guderian

EFFECTS OF AIR POLLUTANTS ON PLANTS. (Wirkungen von Luftverunreinigungen auf Pflanzen). Text in German. In: Fundamentals of Air Conservation and Noise Abatement in North Rhine Westphalia, p. 40-46, 1975.

The effect of air pollution on plant life is discussed. Photosynthesis is impaired, acute necrosis of leaves and chronic damage involving sublethal changes due to increasing accumulation of pollutants occurs. Damage to vegetation is often an early indicator of intolerable atmospheric pollution, resulting in measures taken against the sources. Most pollutants produce injury to plant life at concentrations apparently irrelevant for man. Sensitivity of plants to hydrogen fluoride, compared to man s response threshold, is 0.3-1.4 microgram F/cu m: 50 micro g F/cu m. Phytotoxicity of air pollutants over a total area of 3000 sq km with a regional resolution of 5 km was examined. Among them were sulfur dioxide, gaseous fluorine compounds, hydrogen chloride, nitrogen oxides, photooxidants, and dust. A pasture grass was exposed for 2 wk, then examined for its content of sulfur, iron, lead, zinc, and cadmium.

84477

Solinski, Piotr

THE EFFECT OF FLUORINE EMISSION FROM A GLASS FACTORY ON THE SURVIVAL OF SILKWORM CATERPILLARS. (O wplywie Emisji Fluoru Z Hut Szkla Na Przezywalnosc Gasienic Jedwabnika Morwowego). Text in Polish. Pol. Pismo Entomol., 43(2):415-422, April 30, 1973.

The effect of fluorine emission from a glass-manufacturing plant on breeding silkworms in the vicinity and mulberry leaves on which they fed, was studied in order to demonstrate the toxicity of fluorine compounds. A total of 1000 silkworm caterpillars, strain K-110, were divided into 2 groups of which 1 was prophylactically dabbed with 1% chloramine solution in order to limit external infection while the 2nd one was not treated. On the 2nd and 3rd days after shedding, about 70% of the caterpillars showed symptoms of poisoning, such as sluggishness, skin darkening, cessation of feeding and, finally, death. The remaining caterpillars died at a later development stage. Their bodies hardened within 2 days into a fossil-like consistency. The results obtained from both groups, revealed that the percentage of dead caterpillars in both groups was the same. A number of 41 cocoons collected, showed differences in size, weight and shape. The heaviest female cocoon weighed 2.22 g, the lightest male one 0.975 g. Of the 41 cocoons, 28 were healthy and 13 were sick with 9 dead nonpupated caterpillars and 4 dead pupae. Out of 4 pairs of copulating butterflies, 1 female laid partly fertilized eggs; the eggs of the rest were not fertilized. The chemical analysis of dead caterpillars and mulberry leaves which they ate showed a content of 0.0506% fluorine, with 0.613% in the ashes of the former and 0.1352% Fl2 in the ashes of the latter. It was also present in the feces of the caterpillars and their silk. The possibility of fluorine poisoning of other organisms, such as useful insects, breeding animals, and even man, was raised.

84484

Dolhova, L. H. and Z. T. Kosyukina

BIOLOGICAL PURIFICATION OF ATMOSPHERE IN COKE-CHEMICAL PRODUCTION. (Do pitaniya pro biologichne ochishchennya atmosferi v umovakh koksokhimichnogo pidpriemstva). Text in Ukranian. Ukr. Bot. Zh., 29(2):172-176, 1972. 14 refs.

Plants play an important role in biological purification of the atmosphere, accumulating sulfur compounds, chlorine, fluoride, and phenol. Soils also have the capacity to accumulate toxic substances of industrial origin. Phenols are among the most toxic environmental pollutants reaching the atmosphere with other compounds as a result of chemical and coke-chemical production. The ability of certain plants and soil under them to accumulate airborne phenols was studied. Experiments were conducted under conditions of continuous exposure to chemical substances (phenols, sulfur compounds) to determine the action on leaves of ailanthus (Ailanthus altissima Sw.), ash (Ulmus pinnato-ramrose Dieck), and poplar (Populus nigra L.). Determinations of phenol-destroying microorganisms were made in order to study soil phenol-detoxifying ability. Data obtained from experiments warrants the following conclusions: leaves of plants studied which grew for 14-16 yr in a phenol- polluted atmosphere contain visibly higher amounts of phenols compared to a control group from a botanical garden. The phenol content of soil under the plants studied was also higher than in the control group. Raised phenol content in leaves and soil is possibly connected with their ability to accumulate and collect industrial phenols found in polluted atmosphere.

84527

RESULTS OF DAMAGE OF MULBERRY FIELDS BY SMOKE AND SOOT. (Baien ni motozuku soen no higai-chosa). Text in Japanese. Gifu-ken Kogai Kenkyusho Nenpo. (Ann. Rep Gifu Inst. Environ. Pollut.), no.2:35, 1975.

Damage to mulberry fields in August 1971 in Kani County and in September 1971 in Ena City due to smoke and soot from potteries was investigated. Measurement of fluorine in mulberry leaves of trees grown near the potteries and in raw materials used in the potteries was carried out. The fluorine content of the raw materials ranged from 9.2 to 24.7 mg/100 g of sample. The damage to silkworms and mulberry trees was most severe around the pottery in which no exhaust treating apparatus was installed. The content of fluorine in mulberry leaves around the pottery ranged from 10.0-15.8 mg/100 g dry weight as compared to 4.4 mg/100 g for the control. When silkworms were fed with fluorine-containing mulberry leaves, it was found that leaves containing more than 100 ppm of fluorine gave some symptoms of intoxication.

84541

Kuribayashi, S.

SILKWORM DAMAGE DUE TO AIR POLLUTANT FLUORIDES. (Fukkabutsu no taikiosen ni yoru kaiko no higai). Text in Japanese. Taiki Osen Nyusa (Air Pollution News), no. 74:1, 1973.

In the vicinity of aluminum, phosphate fertilizer, roof tile, and glass factories, silkworms often suffer from intoxication and insufficient growth, resulting in imperfect cocoon formation and death. The cause is fluorides which have been exhausted in minute concentration of S from the factories, and have been deposited on the mulberry leaves which the silkworms ingested. When the fluoride content of mulberry leaves, usually about 15 ppm (dry matter), becomes more than 30 ppm, the silkworms show inactivity, delayed growth, and weight loss, and then die prostrated. Sometime the intoxicated silkworms show a blackening of internodal membranes not seen in intoxication due to other causes.

84545

Kuribayashi, S., K. Yatomi, and M. Kadota

EFFECTS OF HYDROGEN FLUORIDE AND SULFUR DIOXIDE ON MULBERRY TREES AND SILKWORMS. (Fukkasuiso oyobi nisanka io no kuwa oyobi kaiko ni oyobosu eikyo). Text in Japanese. Taiki Osen Kenkyu (J. Japan. Soc. Air Pollution), vol. 6:155, 1971.

Potted mulberry trees were exposed to hydrogen fluoride at 30 and 200 ppb for 4-72 hr, and to sulfur dioxide at 2 ppm for 8-72 hr to determine the leaf injury and amount of fluorine in the leaf. The effects of feeding the exposed leaves to silkworms were examined. Visible damage (browning and curling from the apex and periphery of leaves) began after 14 hr exposure to 0.13 ppm and 2 hr exposure to 0.2 ppm. About 120-160 ppm of fluorine accumulated (dry matter) in the damaged leaves. The silkworms continuously ate leaves containing 35-70 ppm of fluorine (dry matter), and showed chronic symptoms such as softening and black spots on the internodular membrane. Those fed with leaves containing more than 90 ppm showed acute intoxication with inactive behavior, then prostration leading to death. In the case of sulfur dioxide exposure, visible injury appeared after about 72 hr of exposure to 2 ppm of sulfur dioxide, in the form of oil-immersion-like spots, with 0.8% sulfur (dry matter). The silkworms which ate these injured leaves continuously showed loss of appetite, inactive behavior and poor growth, with chronic symptoms such as slenderness, growth retardation, or softening leading to death.

84548

Matsui, T., Y. Nishi, and C. Asai

CLASSIFICATION AND SURVEY OF AIR POLLUTION BY BIOLOGICAL INDICATOR PART 2. (Seibutsu shihyo ni yoru taikiosen no bunkyu to shindan (2)). Text in Japanese. Kankyo Joho Kagaku (Environ. Inf. Sci.), 5(2):61-72, 1976. 20 refs.

In order to establish a monitoring system for air pollution using biological indicators, 41 points were selected in the hinterlands of Ube and Onoda. Pollution sources were in the coastal industrial zone. A case study was carried out in classification of the degree of air pollution using epiphytic bryophytae, measuring soil respiration, the components of matter adhering to leaves, the sulfur content of leaves, the activity of vegetation, and the flowering of Osmanthus fragrans in the winter of 1973 and summer of 1974. Pollution sources were found to be sulfur dioxide with relatively less fluorine, dusts, and auto exhaust. Epiphytic bryophytae and the activity of vegetation were sharp indicators of the cumulative effects of low concentrations of air pollution. Soil respiration coincided well with these indicators. Sulfur content was found not to be as appropriate an indicator as the adhered matter on leaves, sulfur dioxide, sulfuric acid, and fluorine. The flowering of O.f., although affected by salty wind, seemed to be a fairly effective indicator of air pollution by sulfur dioxide. The status of air pollution in the two cities was found to depend on topological abnormality of wind direction. In these situations, biological indicators were found to be effective in indicating air pollution in lower concentrations for long-term exposure.

84551

Nakajima, Y.

RESULTS OF DETERMINING FLUORINE CONTENTS OF AGRICULTURAL CROPS. (Nosakubutsu no fusso ganyuryo choya). Text in Japanese. In: Fourth Prefectural Report on the Results of Survey on Air Pollution in the Naoetsu Area. Niigata Prefectural Office (Japan), p. 76-85, Aug. 1975.

Fluorine contents of agricultural crops collected around an aluminum refinery in the Naoetsu area were analyzed by the distance from the refinery, the type of crops, and the season. By comparing the plant contents with the environmental concentration (LTP method) the actual state of pollution was determined with the intention of finding indicator plants and determining the inhabitants intake of fluorine. At first, equiconcentration curves of fluorine content of air with more than 100, more than 50, more than 20, and less than 20 micrograms/sq dm LTP/mo were drawn on the map. The value in the predominant wind direction was about 20 micrograms at a distance from the refinery of 4 km. The fluorine content was higher in leaf-vegetables, fruit-vegetables, and polished rice than in respective controls. Root-vegetables contained lower amounts of fluorine. According to distance from the refinery without regard to wind direction, a trend of reduction of fluorine content was found; however, it was not significant in all vegetables except for polished rice, leaves of Japanese radish and eggplant. By distance, in the predominant wind direction, the content of fluorine showed negative correlation to the distance from the refinery in polished rice, leaves of potato, spinach, Japanese radish and eggplant. There was a significant correlation between environmental air concentration and the content of fluorine. One sample of Chinese cabbage contained fluorine as high as 10 ppm. Spinach was considered to be appropriate as an indicator of fluorine in air, because it gave a correlation between fluorine content and distance, fluorine content and wind direction from the refinery, and fluorine content environmental concentration of fluorine.

84553

Nakajima, Y.

RESULTS OF SURVEY ON PLANT DAMAGE DUE TO FLUORIDE. (Fukkabutsu ni yoru shokubutsu higai chosa). Text in Japanese. In: Fourth Prefectural Report on the Result of Survey on Air Pollution in the Naoetsu Area. Niigata Prefectural Office (Japan), p. 86-113, Aug. 1975. 9 refs.

In order to elucidate the relationship between environmental fluorine concentration and the fluorine content of agricultural crops and that between visible injuries of crops and crop yield, potted plants of spinach and Welsh onion (both in spring and autumn) and gladiolus were put in locations 200, 500, 1000, 1500 and 2500 m. from an aluminum refinery and their growth and the degree of injury (damaged leaf area of spinach and leaf withering of Welsh onion and gladiolus) was surveyed as well as the fluorine content. Rice plants planted around the refinery were also similarly investigated. The injury to spinach due to fluoride in air appeared in both seasons as shortness, shrunken and whitened leaves, and low yield and growth,

especially in places within 1 km of the refinery. Welsh onion was damaged by downy mildew. Gladiolus plants within 1 km of the refinery showed were withered up to the VI leaves. There were high correlations between the fluorine content of crops and fluorine concentration in the air (LTP value), between the degree of injury and fluorine content of crops, and between the degree of injury and fluorine content in air (LTP value).

84557

Kadota, M., Y. Yumiba, and A. Tanaka

PLANT DAMAGE DUE TO AIR POLLUTION. (Taikiosen ni yoru shokubutsu higai). Text in Japanese. Anzen Kogaku (J. Japan. Soc. Safety Eng.), 10(4):189-196, 1971. 2 refs.

A general description is given of plant damage, mainly discoloration and spots on leaves due to air pollutants such as sulfur dioxide, sulfuric acid mist, chlorine, hydrogen chloride, hydrogen fluoride, ozone, peroxyacetyl nitrate, and nitrogen dioxide. Every air pollutant and the acute and chronic symptoms it causes as well as the characteristic methods of causal identification are described. Species specific sensitivity of plants such as herbs and agricultural crops to each air pollutant are also given.

84558

Sugimoto, E.

STUDIES ON DAMAGE DUE TO AIR POLLUTION-ON THE FLUORINE CONCENTRATION IN NEEDLES OF PINES IN FUKUI AND SAKAI AREAS. (Taikiosen ni yoru jumoku no higai ni kansuru shiken, Fukui, Sakai chiku ni okeru matsu shinyo chu no fusso nodo ni tsuite). Text in Japanese. Fukui-ken Ringyo Shikenjo Hokoku (Annu. Rep. Fukui Prefect. For. Exp. Stn.), no. 13:96-101, 1975. 4 refs.

Samples of needles of Pinus thunbergii and P. densiflora grown at points in Fukui and Sakai 1, 2, 3, 5, and 7 km remote from a place where factories were to be built were taken yearly for 3 years beginning in 1972, early in August when the growth of new leaves is finished. The fluorine content of the samples was determined. The average for 3 years of new leaves for P.t. was 0.8-2.6 ppm (average of 1.6 ppm); second year leaves of P.t. showed 2.4-3.7 ppm (average of 3.1 ppm); third year new leaves of P.d. had 1.4 ppm, second year leaves 3.1 ppm. When these values were compared to those in air polluted areas and non-polluted areas, it was found that the fluorine content of pine leaves collected in the Fukui and Sakai areas was in the range of natural environmental concentrations. There was a difference of fluorine content between new leaves and second year leaves, the latter containing more fluorine. This was due to more absorption of fluorine via roots.

84579

Sakurai, S., K. Itai, and F. Tsunoda

STUDIES ON AIR POLLUTION DUE TO FLUORIDES. PART 17. ON THE NORMAL CONCENTRATION OF FLUORINE IN PLANTS. (Jukkabutsu ni yoru taikiosen ni kansuru kenkyu XVII. Shokubutsu chu fusse nodono tsujochi ni tsuite). Text in Japanese. Nippon Eiseigaku Zasshi (Japan. J. Hyg.), 31(1):174, April 1976.

The normal concentration of fluorine in 3 indicator plants and crops grown in an area where total fluoride was less than 0.05 microgram F/cu m is reported. In iris, the content of F in upper, middle, and lower leaves was respectively 4.21 (8.88-1.68), 2.81(6.35-0.75), and 1.89 (4.00-0.80) ppm. In pine needles it was 2.95 (5.86-1.10), 3.83(6.25-1.91), and 4.61 (6.46-2.56) respectively in first-year, second-year and third- year needles, showing yearly increases. There are also cases where the content differs from spring to autumn. The leaves of samellia a(as tea leaves) contained high amounts of fluorine ranging from 90 to 600 ppm.

84650

Ishikawa, H.

ON THE RELATION BETWEEN THE BROWNING OF PHYLLOSTACHYS HETEROCYCLA VAR. PUBESCENS AND AIR POLLUTION PART 1. (Mosochiku no kappengensho to taikiosen tono kankei ni tsuite (1)). Text in Japanese. Shokubutsu to Shizen (Plants and Nature), 10(5):28-33, May 1976. 9 refs.

In order to select indicator plants for fluorine gas in the air, several plants grown in southern mountainous areas were surveyed near the Niihama industrial area, and general browning of the leaves of Phyllostachys heterocycla (variety pubescens) grown in an area 600-800 m from the fluorine factory was observed (the leaves of the same plants showed a light green color when they grew 8 km from the factory). A detailed survey on the same plants grown in 23 places indicated that (1) The newly developed leaves of P.h.p. in all places were bright green in color in July. (2) Browning of the leaves of plants near the factory increased. (3) In April of the next year, almost all the leaves of the plants near the factory showed severe browning, and (4) The degree of browning was more severe as distance from the factory decreased.

84651

Masujima, H.

THE AGGRAVATION FO AGRICULTURAL PRODUCTION AND COUNTERMEASURES. (Nogyo seisan kankyu no akka to sono taisaku). Text in Japanese. Nogyo to Keizai (Agriculture and Economy), vol. 1976: 37-43, 1976.

Japan is the country most deeply impacted by environmental pollution as it affects food production in the world. Air pollutants which attack agricultural products include ozone, peroxyacetyl nitrates, nitrogen dioxide, sulfur dioxide, hydrogen fluoride, chlorine, and ethylene. The specific susceptibility to each pollutant of taro, lettuce, tomato, alfalfa, gladiolus, rice, and cattleya is given. The characteristic symptoms are spots on the leaves (white and brown in color), metallic color on the lower surface of the leaves, spots (white to brown in color) in the mesophyll, whitish-yellow from the leaf periphery, bleached spots between leaf veins, and withering of the sepal apex, in that order. Metal-containing dust affects agricultural crops. The importance of invisible damage that occurs before visible damage appears is emphasized. There is no direct countermeasure against the primary pollutant. The countermeasures against secondary pollutants such as photochemical oxidant are now under field study techniques; such as shading, limitation of irrigation, and misting are considered. Damage-reducing agents are under study for use before the occurrence of photochemical smog. Air pollutants affect human health as well as crops.

I. EFFECTS-MATERIALS

00085

S. Kleinberg, J.F. Tompkins, Jr., A.H. Singleton, C.J. Sterner

THE PROPERTIES AND HANDLING OF FLUORINE. Air Products and Chemicals, Inc., Allenton, Pa. (Technical Documentary Rept. ASD-TDR-62-273.) Oct. 1963. 139 pp. DDC: AD 423751

This report p*resents data on properties of fluorine, methods of analysis, safe-handling procedures, compatibility of materials of construction with fluorine, corrosion rates of metals, and a bibliography of pertinent references. Special attention is given to the compatibility of materials in fluorine. Most metals are not severely corroded by pure fluorine. The presence of hydrogen fluoride (HF) in fluorine increases corrosion of metals markedly. The HF is usually generated in fluorine systems from the reaction of atmospheric moisture or moisture in the system with fluorine. Contaminants in fluorine other than HF do not present corrosion or safety problems. Cleanliness of a fluorine system is emphasized since contaminants may not be removed from the apparatus by passivation procedures. Most corrosion in a liquid fluorine system occurs during the first hour of exposure. When immersed in liquid fluorine for one year, nickel, Monel, 304 stainless steel, Armco steel 15-7 Ph Mo, and copper corroded less than 5 mils; 410 stainless steel less than 70 mils; aluminum 1100, 6061, titanium A100At and C120Av less than 300 mils; magnesium AZ31 less than 350; and magnesium A1C31 less than 700 mils. Data are given for corrosion of metals in gaseous fluorine at various temperatures.

00695

R. V. Chiarenzelli and E. L. Joba

THE EFFECTS OF AIR POLLUTION ON ELECTRICAL CONTACT MATERIALS: A FIELD STUDY. J. Air Pollution Control Assoc. 16, (3) 123-7, Mar. 1966. (Presented at the 58th Annual Meeting, Air Pollution Control Association, Toronto, Canada, June 20-24, 1965.)

A long-term field and laboratory program designed to determine and understand the effects of air pollutants on electric contact materials and their performance has reached the one-year mark. An extensive variety of precious and nonnoble metals and alloys has been exposed for periods ranging up to one year (August 1963 to August 1964) at 6 field environments. These environments were selected to provide a wide range of air pollutants in typical data processing or process control situations and comprise such diverse locations as an air-conditioned data processing room in New York City, an east coast oil refinery, an east coast chemical plant, a business location in Los Angeles, a paper mill in the south, and a heavy manufacturing plant in Buffalo. The program undertakes to correlate material degraduation as a function of time and environment. Humidity, temperature, and sulfur dioxide are measured on a continual basis, and point-in-time measurements of dust, HF, aldehydes, oxidants (ozone), NO2, SO2, H2S, NH3, and Cl are made on a quarterly basis. Materials are returned periodically and evaluated in the laboratory by contact resistance probing, electrolytic reduction, and standard metallographic techniques. The results of the program to date are presented, and preliminary correlations are drawn. The program is evaluated from the vantage point of the one year mark. Deficiencies and aspects of special utility are described. (Author abstract)

07553

Yocom, John E.

THE DETERIORATION OF MATERIALS IN POLLUTED ATMOSPHERES. J. Air Pollution Control Assoc., 8(3):203-208, Nov. 1958. 34 refs. (Presented at the 14th Annual Conference and 1958 Exhibition, National Assoc. of Corrosion Engineers, San Francisco, Calif., March 20, 1958.)

A group of specific air pollutants known to produce deterioration of materials, the principal sources of these pollutants, and the most likely mechanisms by which deterioration of a variety of materials can occur are discussed. Specifically, the pollutants are carbon dioxide, sulfur dioxide, sulfur trioxide, hydrogen sulfide, hydrogen fluoride, ozone and solid particulates.

08076

Gunther, William H. and Martin J. Steindler

LABORATORY INVESTIGATIONS IN SUPPORT OF FLUID-BED FLOURIDE VOLATILITY PROCESSES. PART XIV. THE CORROSION OF NICKEL AND NICKEL ALLOYS BY FLUORINE, URANIUM HEXAFLUORIDE, AND SELECTED VOLATILE FISSION PRODUCT FLUORIDES AT 500 C. Argonne National Lab., Ill., Chemical Engineering Div., 40p., Dec. 1966. 26 refs. CFSTI: AML-7241

The corrosion of selected materials of construction by fluorides of interest in the Fluoride Volatility Process has been studied. The metals investigated include: nickel-200, nickel-201, Monel, Inconel, Duranickel-301, HyMu-80, INOR-8, and nickel-200 coupons containing areas of nickel-200 weld, nickel-61 weld, or silver solder. Exposures of these metals for periods up to 30 hr at 500 C were carried out in elemental fluorine, UF6, SF6,and some of the following volatile fission product fluorides, both individually and in the presence of fluorine: GeF4, AsF5, NbF5, SbF5, BrF5, SeF6, MoF6, and TeF6. Corrosion rates were calculated from both the weight gain of the coupons after exposure and the weight loss of the coupons after descaling in a KNO3-NaNO3 bath at 500C. All of the exposed coupons were examined microscopically for intergranualar penetration of the base metal.Nickel-200 and Monel exhibited the best overall resistance to corrosion by fluorine, UF6, and some of the volatile fission product fluorides individually and in the presence of fluorine at 500 C. AA

23108

Mizutani, Masumi

WATER POLLUTION DUE TO AIR POLLUTION. (Taiki osen ni yoru suishitsuosen). Text in Japanese. Kukichowa to Reito (Air Conditioning Refrig.), 10(2):41-51, Jan. 15, 1970.

Bursting of copper condenser pipes of air conditioners and refrigerators rapidly increased since 1966. Five hundred incidents were recorded in the summer of 1969 in the Osaka area. The primary cause of the incidents was found to be the air pollution from flue gas from factories and automobile exhausts. Construction materials of the cooling system for cooling towers, for example, iron, copper zinc, aluminum, and their alloys, can be corroded or pitted by the following pollutants: NH3, SO2, H2SO4, HF, HCN, HCHO, H2S, HCl, NO2, CH2 equals CHCHO, Cl2, CS2, HSO3Cl, and Br2. The water for th condenser iis polluted by sulfur dioxide in the atmosphere and by the other pollutants from metal plating, acid rinsing, rubber, and other chemcial processes. Ammonia in the exhaust from lavatories or sewage processing plants also becomes the source of corrosion. The cooling water pollution was also found in the vicinity of heavy traffic intersections, polluted rivers, and at the seaside. A cooling tower installed near an ammonia refrigerator had a trouble of this kind. Even in the countryside, insects sucked into a cooling tower caused water pollution. Countermeasures, such as checking the cooling tower, the use of tower water corrosion tester and anticorrosion agents are described. A sample of Water Quality Check List Card is presented. The paper concludes with a gloomy view of more air pollution and corrosion troubles in the future.

24308

Mammarella, Luigi

PRINCIPAL EFFECTS OF POLLUTION AND DETERIORATION PHENOMENA DUE TO AIR POLLUTION. (I principali effetti degli inquinamenti e i fenomeni di deterioramento dovuti alle contaminazioni dell' aria). Text in Italian. In: L'inquinamento Atmosferico in Italia. Rept. 27, p. 54-69, 1970. 110 refs.

The effects of pollution on human health, on natural resources and the economy, on building materials, and on plants and animals are reviewed. Reduced visibility and climatic changes resulting from air pollution ar also discussed. Among the materials damaged by pollution, the following are mentioned: building stone, textiles, metals, paints, rubber, leather, and paper products. A list is given of types of plants that are highly sensitive, moderately sensitive, and resistant to sulfur dioxide and to the fluorides. A tabulation is also given of the climatic effects of dusts and aerosols, SO2, carbon dioxide, and carbon monoxide, quoted from an American author.

27060

Yocom, John E.

EFFECTS OF AIR POLLUTION ON MATERIALS. In: Air Pollution. Arthur C. Stern (ed.), Vol. 1, New York, Academic Press, 1962, Chapt. 7A, p. 199-219. 42 refs.

Air pollution damage to nonliving materials has long been a significant source of economic loss in urban areas. Some of this loss results directly from damage by pollutants such as the corrosion of metal objects, or the weakening and eventual loss of textile or leather articles by direct action of pollutants. The other portion of this loss is indirect and includes, for example, the increased cost of clothing replacement because of excessive cleaning required by a polluted environment, or the loss in property values in highly polluted areas. Mechanisms of deterioration in polluted atmospheres include abrasion, deposition and removal, direct chemical attack, indirect chemical attack, and electrochemical corrosion. Among the most important factors that influence the attack rate of damaging pollutants are moisture, temperature, sunlight, air movement, and position in space. The measurement of materials deterioration is reviewed. Effects of carbon dioxide are noted. Sulfur dioxide has its principal sources in combustion or roasting operations, and its effects are noted on ferrous metals, aluminum, copper, nickel, building materials, leather, paper, and textiles. The effects of hydrogen sulfide on metals and paint are described. Hydrogen fluoride can attack window glass to the extent that the glass is rendered opaque. Effects of ozone and photochemical smog are discussed for rubber and elastomers, textiles, and dyes. The role of solid air particulates in causing deterioration is normally to produce soiling. Their effect is discussed for metals, building materials, painted surfaces, and textiles. Much of the particulate matter which is responsible for soiling is in the form of minute liquid or semi-liquid droplets.

39031

Steelman, Clarence, Jr.

USE OF PLASTICS TO CONTROL AIR AND WATER POLLUTION. Materials Protect. Performance, 11(4):37-40, April 1972.

Areas of application for plastics in equipment and processes designed to control air and water pollution are reviewed. The importance of plastics, e.g., polyvinylchloride, polyethylene, polypropylene, and teflon, lies in their ability ot withstand corrosion. Plastics, therefore, are in use as construction materials for control devices and process equipment such as ductwork, fume scrubbers, regeneration systems, pumps, and piping exposed to hydrochloric acid fumes and pickling acid in the hot rolled steel strip pickling process in steel mills; tanks for storing sulfuric, hydrochloric, nitric, and hydrofluoric acid mixtures and exhaust hoods and fume scrubbers in the wire, rod, bar, and tube pickling processes of steel mills; in the chrome plating of steel strips; reaction tanks in the electroplating rinse water treatment; scrubbers and scrubber liquid recirculation systems exposed to ammonia gas in fertilizer plants; water jet fume scrubbers used with corrosive fluoride compounds in the production of super phosphate fertilizer; plate separators for the removal of insoluble oils; within water and sewage treatment plants; and fume scrubbers, exhaust fans, ductwork, and stacks within chemical industries.

40510

Fabian, Robert J. and John A. Vaccari

HOW MATERIALS STAND UP TO CORROSION AND CHEMICAL ATTACK. Mater. Eng., 73(2):36-59, Feb. 1971.

A detailed report is presented concerning the resistance of metallic and nonmetallic materials to corrosion and chemical attack. The metals studied include: aluminum, beryllium, cadmium, carbon steels, cast irons, chromium, cobalt, copper, lead, low alloy steels, magnesium, molybdenum, nickel, precious metals, stainless steels, tin, titanium, wrought iron, zinc, and zirconium. The nonmetallic materials include rubber, graphite, nylon, and many synthetic materials. The effects of air, sea water, and fresh water on these materials are reported. The effects of many acids were studied, including: acetic, boric, chromic, citric, fatty, formic, hydrochloric, hydrofluoric, nitric, phosphoric, and sulfuric. Other agents studied for their effects on these materials include: bases and salts; solvents and cleaners; oils, fuels, and petrochemical fluids; and other chemicals, such as ammonia, chlorine, bromine, and sulfur dioxide. There are two shortcomings in the data presented. First, there is a wide disparity in the types of tests used by investigators. Also, there are many exceptions to the general rule that the speed of a chemical reaction increases with increasing temperature. Some materials may reverse the usual pattern as temperature increases or decreases.

40833

Dicke, C. M. and M. J. Reidt

PROTECTION OF ALUMINUM BUILDING-CONSTRUCTIONS. (De bescherming van aluminium bouwconstructies). Text in Dutch. TNO-Nieuws, 26(6):219-227, March 1971. 6 refs.

Various techniques for the protection of aluminum construction and parts from corrosion are reviewed. Fluorides, heavy metals, alkali compounds, chlorides, and sulfur compounds are the most dangerous air pollutants for aluminum and its alloys. Humidity, especially 100% humidity and presence of chlorides, sulfur compounds, soot, or smoke are the basic factors to be considered in the choice of an adequate protecting system. Problems of the contact of aluminum and its alloys with other metals and other materials are reviewed. While the rate of contact corrosion is determined by the presence of water, and influenced by both conductivity and polarization, such corrosion can be prevented or considerably reduced by an oxide layer of 20 micron. Zinc coatings provide satisfactory cathodic protection in normal atmospheres, but their effect in an aggressive atmosphere is doubtful. Cadmium, applied in thinner layers than zinc, can replace the latter in corrosive atmosphere. Copper coatings should not be applied to construction exposed to weather, especially in an industrial atmosphere; such coatings, applied in 20 micron-anodic layers, do provide satisfactory protection for indoor parts. Stainless steel coatings may be applied in a mild climate, but not in seashore areas. The same applies to chromium-nickel coatings, while lead coatings protect aluminum and aluminum-magnesium-silicon alloys. The natural oxide layer of 0.01-0.1 micron, formed on the aluminum surface, or additional chromate or phosphate coating, are sufficient in non-corrosive atmosphere conditions, while increased oxide layers with a maximum thickness of 35 micron, or paint are required in aggressive atmospheres. Anodizing and lacquering techniques for aluminum are reviewed.

46606

CORROSION DUE TO AIR POLLUTION. (Corrosie door luchtverontreiniging). Text in Dutch. Polytech. Tijdschr., Ed. Procestechniek, 27(18):582-597, Aug. 1972. 70 refs.

Factors influencing the atmospheric corrosion of materials, the mechanisms of corrosion of different metals, alloys, and nonmetallic materials exposed to air pollutants, particularly to sulfur dioxide, and results of corrosion tests are reviewed. The atmospheric corrosion is dependent on such factors as humidity, precipitation, temperature, solar radiation, and particularly the presence of corrosive substances, primarily oxidizing agents and electrolytes (ozone, nitrogen oxides, nitric acid, organic peroxides, sulfur dioxide, sulfurous acid, sulfur trioxide, sulfuric acid, hydrogen sulfide, hydrochloric, hydrofluoric and other acids, carbon dioxide, ammonium sulfate and other ammonium salts, sodium chloride, dust and rust. The processes of the corrosion of iron, steel, zinc, cadmium, nickel, copper, lead, aluminum and its alloys, stone, textiles, paper, leather, rubber, and glass are described. The corrosion of copper, lead, and aluminum takes places at fairly slow rate due to the formation of protective layers. The rate of corrosion of aluminum in urban and industrial atmosphere was 0.015-0.080 mg/sq dm day. Strong attack of copper-alloyed aluminum in marine atmosphere was observed. Gold, silver, and their alloys are attacked by 3O2 and H2S. Correlations between the rates of corrosion and the average SO2 level in the atmosphere, the humidity content, and the exposure time were established.

47291

THE CATHEDRAL RACES AGAINST TIME. (Der Dom im Wettlauf mit der Zeit). Text in German. Umwelt (Duesseldorf), 2(6):38-39, 1972.

Pollutants in the air are destroying the figures on the cathedral in Cologne, its glass windows, and its ornaments. Wind and weather together with sulfur dioxide from combustion processes, hydrofluoric acid from chemical and metallurgical plants, hydrochloric acid, from incinerators, and trace metals such as vanadium and iron which are catalytically active, constantly attack the structure. Measurements at various heights of the acid waste gas components have already revealed that the sulfur dioxide exposure has reached an extent which is comparable to that in Duisburg.

52320

Luckat, Siegbert

THE ROLE OF AIR POLLUTANTS IN STONE DECAY. (Die Wirkung von Luftverunreinigungen beim Steinzerfall). Text in German. Staub, Reinhaltung Luft, 33(7):283-285, July 1973. 13 refs.

Investigations into weathering phenomena on structures built of natural stone, and comparative considerations in the case of increased emissions (in particular, the measurements of absorption rates of noxious substances) clearly show that air pollutants are one of the causes of stone disintegration. Sulfur dioxide and sulfuric acid which forms from it, must be given here as the main components of pollutants. Four different types of prism-shaped sandstone and one trachyte with a base area of 100 by 200 mm and a height of 300 mm were exposed at four different points in North Rhine Westphalia. One was set up on the premises of the Landesanstalt fuer Immissions- und Bodennutzungsschutz in Essen, one at a heavily polluted point in Duisburg, one in Herten, and one near Burgsteinfurt in the Northern Muensterland. Apart from climatological data, the intake rates for SO2, chloride, and fluoride were determined with the aid of physical-chemical sorption process. The unprotected sample in Duisburg showed the first signs of decay after 6 mo. On the sample in Burgsteinfurt, lichens began to grow. A table lists the emission intake of chloride, fluoride, and SO2 by the four different samples and by the Cathedral in Cologne. At the point in Essen the average SO2 emission intake rate for the period May 10, 1972 to Feb. 27, 1973 was 98.58 mg/sq m/day, for chloride 13.63 mg/sq m/day, and for fluoride 0.815 mg/sq m/day. In Duisburg the average values were 129.84 mg/sq m/day for SO2, 15.77 mg/sq m/day for chloride and 0.789 mg/sq m/day for fluoride. At the Dome in Cologne the average emission intake rate for the period Aug. 8, 1972 to Feb. 27, 1973 for SO2 was 144.27 mg/sq m/day, for chloride 18.00 mg/sq m/day, and for fluoride 1.367 mg/sq m/day.

54961

Detrie, J. P.

POLLUTION AND CORROSION. (Pollution et corrosion). Text in French. Pollution Atmos. (Paris), 15(58):107-116, April-June, 1973.

The parameters influencing corrosion of materials are too variable to make accurate calculations. Corrosion does not depend only upon the action of pollutants produced by human activity, but also upon temperature, humidity, and ionization. Components of the atmospheric air such as sulfur, nitrogen, chlorine, and fluorine compounds, carbon dioxide, and different oxidants also influence corrosion. In France, the sea lo-

calities of Biarritz and La Rochelle with corrosion level one, the rural locality of Saint Germain en Laye with corrosion level one, and the industrial town Saint Denis with corrosion level 2.5 were examined. Sea shore localities are more exposed to corrosion than areas with a high degree of pollution. In the United States, Pittsburgh had a decrease of SO2 from 0.15 ppm in 1926 to 0.5 ppm in 1960. In Chicago, an increase from 0.04 ppm to 0.12 ppm was noted over a 12-month period. Los Angeles has a preponderance of oxidant smogs generated by hydrocarbon emissions. Acid rains in Sweden contributed to steel corrosion. In Stockholm, at 3 C and 35 micrograms/cu m of SO2, the corrosion level was 30/micron/yr. At Flahut, the corresponding values were 3 C, 4 micrograms/cu m SO2 and a corrosion of 8 micron/yr. At Kiruna, the values were -5 C, no SO2, and a corrosion of 2 micron/yr.

56143

Wolff, Arnold and Siegbert Luckat

STUDIES ON THE EFFECTS OF AIR POLLUTANTS ON THE BUILDING MATERIALS OF THE DOME IN KOELN. (Untersuchungen zur Einwirkung von Luftverunreinigungen auf die Baumaterialien des Koelner Domes). Text in German. Proc. Int. Clean Air Congr., 3rd, Duesseldorf, West Germany, 1973, p. A90-A92. 8 refs.

Systematic measurements of the sulfur dioxide, fluorine and chlorine concentrations in the air in and on the dome in Koeln are being conducted to ascertain the causes of the premature stone deterioration. The rate of SO2, hydrochloric acid, and hydrofluoric acid by the building materials of the dome is measured by means of a Luckat type (IRMA) instrument using a basic liquid. In addition, the actual SO2 concentrations are measured continuously and corrosion tests are being conducted. The measuring units are placed at different altitudes ranging from 20 m to 100 m. The measurements revealed above-average exposure of the dome building materials to SO2, HCl, and HF whose concentrations increase with altitude. Rapid increase in the SO2 concentrations from summer to winter was observed. The SO2 concentrations measured late December were about three times as high as those measured late August, which indicates the major contribution by domestic heating and power plants to the overall SO2 emissions.

58585

Nakayama, Masamichi

THE EFFECTS OF AIR POLLUTION ON COATING FILMS. (Taiki osen ni yoru tomaku e no eikyo). Text in Japanese. Kinzoku Hyomen Gijutsu (J. Metal. Finish.), no. 11:29-36, 1973. 11 refs.

The anti-corrosive surface coatings of oil, phthalic acid resin, vinyl, rubber chloride, or epoxyl have been corroded or damaged by various air pollutants. The pollutants causing such damages as discoloring, blistering, peeling, rusting, swelling, and rotting are gaseous pollutants such as sulfur dioxide, sulfur trioxide, hydrogen sulfide, mercaptans, nitric oxide, nitrogen dioxide, nitric anhydride, nitric acid, ammonia, ozone, peroxides, fluoride, chlorine, hydrogen fluoride, hydrogen chloride, acid mists, settling particles, suspended particulates, metal oxide particles, corrosive salts, and marine salts. The degree of damage by these pollutants is heavily affected by their combinations, concentrations, wind direction and velocity, rain quantity, temperature and humidity. The degree of swelling, rusting, and other types of corrosion are much greater in chemical industrial areas with heavy SO2 concentrations, and in humid areas.

63139

Arndt, Uwe and Ute Gross

LONG TERM IMMISSION EFFECTS ON UNPROTECTED WOOD. (Langfristige Immissionswirkungen an ungeschuetztem Natzholz). Text in German. Staub, Reinhaltung Luft, 34(6):225-227, June 1974. 9 refs.

Field experiments to determine air pollution effects on unprotected wood were carried out over a 1-year period in four different locations in North Rhine-Westphalia (the municipal power plant in Duisburg, Essen, Herten, and Burgsteinfurt). Pieces of Pinus sylvestris and Afzelia bipidensis were exposed on a rack with 45 deg inclination facing southwest. Weight and color modifications in the test samples and accumulation of pollutants in the outer layers of the wood served as indicators. Dust fall, sulfur dioxide, and fluorine were measured. Dusts and gaseous pollutants have a significant effect on unprotected wood.

63871

Luckat, Siegbert

RELATIONSHIP BETWEEN THE CORROSION RATE OF STEEL AND THE IMMISSION RATE OF VARIOUS POLLUTANTS. (Beziehungen zwischen der Korrosionsrate von Stahl und den Immissionsraten verschiedener Schadstoffe). Text in German. Staub Reinhaltung Luft, 34(6): 209-213, June 1974. 13 refs.

Steel plates (DIN 1623) of 50 by 100 mm and 1 mm thickness were used for determination of the relationship between the corrosion rate and the emission rate of sulfur-, fluorine-, and chlorine- containing pollutants. For exposure of the steel plates Mank s turret (a pivoted disk with arms driven by the air flow) was used. The emission rate analyzer, which has been described elsewhere, uses the surface of an alkaline liquid as a standardized measurement area. The absorption solutions and Soxhlet-cartridges of the analyzers were collected every two weeks and replaced by new ones. The emission rate was likewise determined every two weeks by replacement of the five exposed steel plates by fresh ones. The weight loss of the exposed plates was determined in the laboratory and the corrosion calculated in grams per sq meter per day. The heavily polluted cities Duisburg, Essen and Herten of the Ruhr valley and Haus Alst outside of the industrial area were selected as exposure sites. The seasonal characteristic of the sulfur dioxide emission rate showed for all measuring sites two to 2.5 times higher values in the winter months than in summer. The concentrations of SO2 in Haus Alst, whose maximum values corresponded to the minimum values measured in Duisburg were surprisingly high. The chloride emission rate showed no marked seasonal characteristic. Several considerable peak values which occured at the same magnitude at all sites deserve mentioning. Fluoride emission rates, too, show no significant seasonal seasonal fluctuation with the exception of the measuring site at the cathedral in Cologne where the values increase significantly during the summer months. The annual average values here are far above those measured in the Ruhr valley. The seasonal characteristic of the corrosion rates corresponded to that of the SO2 emission rates which shows that the corrosion rate of steel can be used as a criterion for the effect of air pollutants. Correlation coefficients will be calculated as soon as more data are available.

65935

Feige, N. G.

TITANIUM FOR INCINERATOR GAS SCRUBBING EQUIPMENT. Mater. Performance, 13(4):17-19, April 1974. 6 refs.

The use of titanium in the construction of wet scrubbers for refuse incinerators is described. Flue gases may contain significant quantities of hydrogen chloride, sulfur dioxide, sulfur trioxide, trace hydrogen fluoride, and organic acids. The titanium is resistant to the corrosive environment in gas scrubbing equipment. Good resistance is predicted in the pH range of 1.5 to 11, and resistance to crevice corrosion at temperatures to 74 C and general pitting attack to 110 C. Trace amounts of iron 3 ions in the system or incorporated in the film should extend the range of immunity to attack. Economics of alternate materials and restrictions in performance limit Ti s application to the inlet and induced draft fan rotor assembly. Titanium can be applied where the environment is aggressive with high levels of HCl as in burning of polyvinyl chloride or when the consequences of unexpected scrubber outage can be costly or dangerous. (Author abstract modified)

69995

Gerhard, Jon and Fred H. Haynie

AIR POLLUTION EFFECTS ON CATASTROPHIC FAILURE OF METALS. Environmental Protection Agency, Research Triangle Park, N. C., Chemistry and Physics Lab., Program Element 1AAOO8, ROAP 21 AMN, Rept. EPA-650/3-74-009, 38p., Nov. 1974. 18 refs. NTIS: PB 238 290/AS

The contribution of air pollution to the catastrophic failure of metal structures through the mechanisms of stress-corrosion cracking, corrosion fatigue, and hydrogen embrittlement is reviewed, with failures being cited for bridges, towers, aircraft, and electrical equipment. An economic analysis of these failures indicates that accompanying injury and loss of life account for an annual economic cost of between $50 million and $100 million. No research has been performed to determine the relationships between levels of particular pollutants and the occurrence of catastrophic failure of metals, although agents known to cause metal alloy corrosion problems include nitrates, caustics, hydrogen sulfide, chlorides, sulfur dioxide, ammonia, fluorides, chlorinated hydrocarbons, and cyanides.

73616

Luckat, Siegbert

THE EFFECT OF AIR POLLUTANTS ON THE BUILDING MATERIAL OF THE DOME OF COLOGNE. PART 2. (Die Einwirkung con Luftverunreinigungen auf die Bausubstanz des Koelner Domes II). Text in German. Koeln. Domblatt, no. 38/39:95-106, 1974.

Results of air pollutant concentration measurements on the Dome of Cologne are presented, and the effect of air pollutants on the building stones is described in comparison to similar building materials exposed in other sites. The sulfur dioxide concentrations were highest during the November-January period, and were higher than the values measured between Junee and August by a factor of 2.5 to 3. The chloride concentrations correlated with the SO2 concentrations at all sites. The SO2, chloride, and fluoride concentrations were higher on the weather side than on the [illegible] side. Good correlation was established between the pollutant concentrations and the corrosion rates measured at the same sites. Correlation was found between the deterioration of the building stones (sandstone) and the pollutant concentrations by a comparison of similar building stones in the Dome of Cologne, situated in a highly polluted area, and those in buildings in less polluted and rural areas.

J. EFFECTS-ECONOMIC

28805

Crocker, Thomas Dunstan

SOME ECONOMICS OF AIR POLLUTION CONTROL. Missouri Univ., Columbia, Thesis (PhD), Ann Arbor, Mich., Univ. Microfilms, Inc., 1967, 274p. 159 refs.

The economic aspects of the atmospheric pollution problem caused by the detrimental effects of airborne fluorides emanating from phosphatic fertilizer manufacturing processes upon the beef cattle and the citrus industries of Polk County, Florida, were studied wit an ultimate view to the economic efficacy of alternative air pollution control policies. A review of the effects of airborne fluorides upon plants and animals gave no grounds for attempting to economically construct meaningful receptor damage functions from these materials. There are two distinct advantages of the use of true sale prices of receptor lands to determine differential receptor damages. First, the market rather than the investigator estimates the near infinitude of relevant relations and their interactions; and second, the responses of the owners of the physical and biological entities damaged by air pollution to varying levels of pollutant fumigations are better taken into account. A cross-sectional, multiple regression analysis of agricultural land values resulted in a positive relation between frequency of pollutant fumigations and the market value of pasture sites; and a negative relation between frequency of pollutant fumigations and the market value of citrus sites. Two basic conclusions about air pollution control policy can be drawn from the Polk County case: 1) the imposition of various physical and economic constraints upon the actions of receptors and emitters can generate gains from trade where all such gains had previously been exhausted; and 2) that assumption absolutely necessary for the economically efficient working of the emitter charge stating that negotiations between emitters and receptors are impossible is not fulfilled in reality.

29923

Schreiber, Michael

THE COSTS FOR MAINTENANCE OF CLEAN AIR. THE INFLUENCE OF SOCIAL COSTS ON THE SELECTION OF AN INDUSTRIAL SITE. (Kosten der Luftreinhaltung. Der Einfluss der social costs auf die industrielle Standortwahl). Text in German. Wasser Luft Betrieb, 15(4):145-148, 1971. 27 refs.

Because of the cost of eliminating brown smoke emissions, Thomas converters were replaced by oxygen lancing converters. An 80-ton Thomas converter emits about twice as much waste gas as an oxygen lancing converter of the same capacity. Similar changeovers to processes with less waste gas production were made i the chemical industry to save waste gas cleaning costs. Sulfur emissions are reduced mainly by switching to low-sulfur fuels, a much less expensive means than desulfurization of the fuel or the flue gases. Such steps are not always possible. In many cases investment in dust collectors, electrostatic precipitators, and scrubbers are unavoidable. The economy of such units depends on the ratio between collection efficiency and maintenance costs. For electrostatic precipitators investment costs rise proportionally to the degree of collection in the efficiency range between 80 and 95%. A collection efficiency of 95 to 98% requires facilities which are 50% larger, increasing costs by 35% and more. The aluminum industry spends an estimated $50/ton of aluminum of its annual production for facilities to eliminate fluorine emission. The annual operating costs per ton of aluminum are estimated at $2.40. Metallurgical plants spent similar amounts for reduction of their emissions.

30226

Bini, Giuseppe

AIR POLLUTION: AN OVERALL VIEW OF THE EFFECTS OF POLLUTANTS AND THE TECHNIQUES USED TO CONTROL THEM. (Inquinamento atmosferico: panoramica sugli effetti degli inquinanti e sulle tecnologie di abbattimento). Text in Italian. Inquinamento, 13(1):27-37, Jan.-Feb. 1971. 29 refs.

The damage caused by pollution is discussed in terms of losses not recovered (the fertilizer industry loses 220 tons of fluorine daily to the atmosphere and two-thirds of the fuel oil burned in heating the city of Milan could be saved by more efficient use of fuel), damage to human health, and damage to man s inheritance in the natural world. Devices for the elimination of sulfur dioxide, nitrogen compounds, and particulate pollution are discussed. Mortality in the United States from asthma, bronchitis and emphysema have increased more than 100% in the last 10 years, while mortality from tuberculosis has dropped to 25% of its previous level. It has been estimated that the cost of pollution in the United States is $50 per person per year. Literature on the recovery of pollutants is reviewed, and schematic drawings are shown of apparatus for the removal of SO2 and the nitrogen oxides, indicating the availability of a wealth of methods and devices for the removal and recovery of the undesirable emissions, even though some are still in the trial stage.

30696

LeSourd, D. A., M. E. Fogel, A. R. Schleicher, T. E. Bingham, R. W. Gerstle, E. L. Hill, and F. A. Ayer

COMPREHENSIVE STUDY OF SPECIFIED AIR POLLUTION SOURCES TO ASSESS THE ECONOMIC EFFECTS OF AIR QUALITY STANDARDS. VOL. I. (FINAL REPORT). Research Triangle Inst., Durham, N. C., Operations Research and Economics Div., APCO Contract CPA 70-60, RTI Proj. OU-534, Rept. FR-OU-534, 395p., Dec. 1970. 328 refs. NTIS: PB 197647

Air pollution control costs for mobile sources are presented on a national basis and in terms of unit investment and annual operating and maintenance costs as well as total annual operating and maintenance costs. The analyses cover the estimated emissions and control costs for new cars for Fiscal Year 1967 through Fiscal Year 1976. Control costs for each stationary source, except for residential heating, are shown for 298 metropolitan areas by investment and annual expenditures by Fiscal Year 1976. The impact of control on selected industries and the Nation are also determined. Finally, an extensive bibliography is included. The pollutants from mobile sources selected for analysis are hydrocarbons, carbon monoxide,

nitrogen oxides and particulates. The six pollutants for which control cost estimates are made for stationary sources are particulates, sulfur oxides, carbon monoxide, hydrocarbons, fluorides, and lead. Emission standards applied are considered stringent in comparison with many currently in use throughout the Nation. Mobile sources include automobiles and light and heavy-duty trucks. Stationary sources studied include solid waste disposal, commercial and institutional heating plants, industrial boilers, residential heating plants, steam- electric power plants, asphalt batching, brick and tile, coal cleaning, cement, elemental phosphorus, grain handling and milling (animal feed), gray iron, iron and steel, kraft (sulfate) pulp, lime, petroleum products and storage, petroleum refineries, phosphate fertilizer, primary non-ferrous metallurgy (aluminum, copper, lead and zinc), rubber (tires), secondary nonferrous metallurgy, sulfuric acid, and varnish. Data essential for defining metropolitan areas, emission control standards, and relevant process and air pollution control engineering characteristics required to support the cost analyses for each source and the cost impact on each industrial process are presented and analyzed in separate appendixes to this report. (Author abstract modified)

32706

Olson, Robert E.

NATURE OF ECONOMIC LOSSES RESULTING FROM THE EFFECTS OF AIR POLUTANTS ON PLANTS. Preprint, Air Pollution Control Assoc., Pittsburgh, Pa., 14p., 1970. 2 refs. (Presented at the Air Pollution Control Association, Annual Meeting, 63rd, St. Louis, Mo., June 14-18, 1970, Paper 70-105.)

A program in progress to estimate the dollar value of air pollution damage to 65 commercially important crops in the U. S. is limited to the effects of ozone, peroxyacetyl nitrate, ethylene, nitrogen dioxide, and fluoride, since these compounds account for at least 90% of such damage. Data on specific air pollution crop damage effects were obtained from plant scientists, while 514 counties with high potential for crop damage from air pollution were identified on the basis of fuel consumption, locations of industrial sources of the compounds under study, and meteorological and topographical conditions. Exposure of plants to pollutants was found greatest near principal urban and industrial centers rather than in major agricultural areas. The level of aggregation was taken as a framework for determining relevant benefits and costs, based on farm production foregone valued at state or county average prices. Thus, for each crop and each county, the three types of data input were production- measured quantity units, producer prices, and estimated yield reduction in percent. A computer program was developed for processing the price, quantity, crop value, and loss data that produces the results for the 514 counties and 65 crops all at once. The computational procedure for estimating economic losses is given, and an example of results presented for Fresno Co., Calif. which includes average price per hundredweight, quantity produced in hundredweights, value of production, and estimated dollar loss for each county crop for the base year 1964.

38409

Lux, H.

FOREST DAMAGES CAUSED BY SMOKE IN SLOVAKIA. (Forstliche Rauchschadprobleme in der Slowakei). Text in German. Soz. Forstwirtsch., 21(2):60-62, 1971.

Proceedings of the Forest and Industrial Emissions Conference held in Slovakia are reviewed. In Czechoslovakia, the total sulfur dioxide emission amounts to 3.4 million t/yr, causing approximately $.09 billion damage to forestry. The corresponding damage caused to forestry in Slovakia lies at $.03 billion. A total forest area of 160,000 ha is affected by air pollution in Czechoslovakia, of which 27,000 ha lie in Slovakia. The damaged agricultural area totals some 600,000 ha. The investments for technical pollution control measures amounted to $1.29 million in 1968, and $5.16 million in 1970. The forestry areas hit hardest by pollution lie in the Erzgebirge (more than 100,000 ha) and in the Ostrava region, with chemical plants and thermal power plants as basic pollution sources. Soil analyses and sensitivity investigations as well as a new method of growth measurement are briefly described. Increasing soil acidification due to sulfur dioxide, chlorine, hydrogen chloride, and hydrogen fluoride gases results in reduced biological activity of the soil, and in nitrogen deficiency. Diagnostic methods and possible connections between emissions and insect proliferation are referred to.

39910

Robinson, J. M., G. I. Gruber, W. D. Lusk, and M. J. Santy

ENGINEERING AND COST EFFECTIVENESS STUDY OF FLUORINE EMISSIONS CONTROL. (FINAL REPORT). (VOLUME I). TRW Systems Group, McLean, Va. and Resources Research Inc., McLean, Va., Office of Air Programs Contract EHSD 71-14, Rept. APTD-0945, SN 16893.000, 411p., Jan 1972. NTIS: PB 207506

Industrial emission sources were inventoried and a study was made of the technical and economic aspects of implementing soluble fluoride emission controls for major industrial sources. Industries included in the study were primary aluminum smelting, iron and steel, electrical power generation, phosphate rock processing, glass manufacture, frit smelting, heavy clay products, expanded clay aggregate, cement manufacture, hydrofluoric acid alkylation processes, HF production, and nonferrous metals smelting and refining. It is technically possible, though not economically profitable, to control soluble fluorides with available devices such as wet scrubbers; the immediate problem lies in implementation of that control, including collection of the evolved fluorides by hoods and similar effluent capture systems for treatment in the abatement devices. Included in the study are discussions of production trends extrapolated to the year 2000, process flow diagrams, estimates of current and projected fluoride emissions analyses of production and control process economics, recommendations for additional research and development programs, environmental and ecological effects of the emitted fluorides on animals, plants, man, glass, and materials, and techniques for sampling and measurement of fluoride pollutants in the various effluent streams.

41121

EXPENDITURES OF THE CHEMICAL INDUSTRY FOR INCREASING ENVIRONMENTAL PROTECTION. (Aufwendungen der Chemie fuer Umweltschutz nehmen zu). Text in German. Chem. Ind. (Duesseldorf), 24(5):272-275, May 1972.

From 1960 to 1969, the chemical industry in the Federal Republic of Germany spent approximately 1.1 billion for environmental protection measures; 36.8% consisted of investments for environmental protection; 42.3%, operation costs for environment protection plants; and 20.6%, for research and development programs. The emissions of sulfur dioxide, carbon monoxide, nitric oxide, fluor and solid particles from the chemical industry were less than 2% of the total emitted quantity. The nuisance of emissions from the chemical industry is due more to bad odors than to gases endangering human health. Investments of the chemical industry for protective

measures against air pollution increased from 34.1% in the period 1960/1964 to 35.1% in the period 1965/69 and will amount to only 24% in 1974.

42746

Bertrand, Rene R.

A STUDY OF MARKETS FOR AIR POLLUTION MEASUREMENT INSTRUMENTATION 1971-1980. Esso Research and Engineering Co., Linden, N. J., Office of Air Programs Contract CPA 22-69-154, 93p., June 1971. 20 refs. NTIS: PB 204174

The market for air pollution instrumentation during the decade of the seventies was determined. The market analysis presented is based on the survey of instrumentation requirements conducted at the federal, state, and local level and on an analysis of current legislation and air pollution control codes. The market for three areas of measurement instrumentation is estimated: ambient level monitoring, stationary source emission measurement, and auto exhaust measurement. This market amounts to nearly $500 million during the coming decade, some 76% of which represents initial purchases of air pollution measuring equipment. Industry will be the major purchaser of instrumentation, accounting for 45% of the market. The market is heavily oriented towards stationary source emission measurement, this area accounting for half the total instrumentation market value. Timing is a critical factor in the market with each of the three areas of measurement reaching maturity at different periods during the decade. In the study of the market for ambient air quality monitoring, only instrumentation required for particulates, sulfur dioxide, oxidants, carbon monoxide, hydrocarbons, nitrogen oxides, fluorides, polynuclear organic matter, and odors is considered. The market estimate for stationary source emission measurement instrumentation includes instrumentation for continuous source monitoring of particulates, SO2, nitrogen oxides, hydrocarbons, CO, and fluorides. (Author abstract modified)

43002

Millecan, Arthur A.

A SURVEY AND ASSESSMENT OF AIR POLLUTION DAMAGE TO CALIFORNIA VEGETATION IN 1970. California State Dept. of Agriculture, Sacramento, Bureau of Plant Pathology, Air pollution Control Office Contract CPA 70-91, Rept. APTD 0694, 51p., June 1971. NTIS: PB 200873

A statewide survey of California was conducted in 1970 to determine areas od occurrence of plant injury due to air pollutants and to assess the damage to agricultural plant crops. Efors were concentrated in areas with known histories of air pollution problems. On the basis of observations and evaluations by agricultural specialists, 1970 crop losses due to air pollutants were estimated at approximately $25,690,680. These losses were confined to 15 to 58 counties in the state. Losses to citrus plantings in the Los Angeles Basin County, with a loss of $10,723,590, experienced the greatest economic crop loss for any one county. The monetary loss figure does not include losses attributed to reduction in crop yield as a result of invisible damage, with the exception of citrus and grapes. Monetary losses to native vegetation including forests or to landscape plantings also were not included. On-the-spot observations made by trained agricultural specialists provided 450 reports, 359 of which recorded plant injury caused by air pollution. Plant injury was observed in 22 counties. Photochemical smog accounted for most of the economic losses. Analysis of the reports showed six pollutants to be involved and accounted for the following percentages of plant injury: ozone 50%, peroxyacetyl nitrates 18%, fluorides 15%, ethylene 14%, sulfur dioxide 2%, and particulates 1%. (Author abstract modified)

43547

Benedict, H. M. and R. E. Olson

ECONOMIC IMPACT OF AIR POLLUTANTS ON PLANTS. VOLUME I. Stanford Research Inst., Irvine, Calif., Coordinating Research Council Contract APRAC-CAPA-2-68, Report CRC-CAPA-2-68-1, 68p., Jan. 1971. 13 refs. NTIS: PB 200235

The loss in dollars that occurs annually as a result of the effects of air pollutants on plants has been estimated. The program has involved individuals trained in agricultural economics and in physiologic and pathologic reactions of plants to air pollutants. The study was limited to the effects of ozone, peroxyacyl nitrates, nitrogen dioxide, sulfur dioxide, and fluorides, as these compounds appear to account for at least [illegible]% of the damage to vegetation by air pollutants. In the initial phases of the study, estimates of loss are limited to the direct effects of these pollutants on yield, quality, and marketability of important commercial crops, with losses for ornamental plants based on losses to vendors. Dollar loss estimates were made for each crop reported for each county where air pollution sources apparently existed. These estimates included losses due to ozone, nitrogen oxides, PAN, sulfur dioxide, and fluorides. (Author abstract modified)

44672

Benedict, H. M., C. J. Miller, and R. E. Olson

ECONOMIC IMPACT OF AIR POLLUTANTS ON PLANTS IN THE UNITED STATES. (FINAL REPORT). Stanford Research Inst., Menlo Park, Calif., Coordinating Research Council Contract CRC-APRAC CAPA-2-68(1-70), SRI Proj. LSD-1056, 77p., Nov. 1971. 37 refs. NTIS: PB 210667

An investigation was made to develop gross estimates of economic losses resulting from the effects of air pollutants on plants. In a previous report, estimates of severity of pollution in various counties were based on emission data only, and the effects of meteorological and other factors in concentrating or diluting these emissions were not given proper consideration. In estimating the loss of individual crops, it was assumed that crops considered sensitive to a given pollutant were equally sensitive and those resistant were equally resistant. The present report is aimed primarily at revising the estimates to correct the deficiencies just mentioned and to include estimates of loss to ornamental plants. Revised estimates of dollar losses due to oxidants (ozone, peroxyacetyl nitrate, and nitrogen oxides), sulfur dioxide, and fluoride are presented.

48171

Fredriksen, Heige

POLLUTION PROBLEMS IN THE NORWEGIAN INDUSTRY. (Forurensningsproblemer in norsk industri). Text in Norwegian. Tidsskr. Kjemi, Bergvesen, Met., 32(2):9-14, Feb. 1972.

The state of pollution control and planned investments in various branches of industry in Norway are reviewed. In addition to $70,000,000 already invested in industrial emission control, about $14,000,000 more will be necessary over the next few years. The aluminum industry, with a yearly output of 500,000 tons, has completed a comprehensive emission control program. Some 8000 tons of fluorides, out of a total of 10,000 tons, are collected. The operating cost of cleaning equipment adds $5.60 to the cost of 1 ton of aluminum. Red smoke emissions from iron and steel plants have been considerably abated, from 1000 to 20 kg/hr in one case. The additional costs are 70-118 cents. The chemical industry has invested $9.52 million for emission control equipment, whose operating costs are $9.3 million/yr. Oil refineries, emitting considerable amounts of sulfur dioxide, soot, and hydrocarbons, will invest $1.4 million over the next 2 years in addition to a $2.1 million invest-

ment already realized. One refinery recovers 6000 tons of sulfur from high-sulfur raw products yearly. Cement works have invested $5.60 million for electrostatic dust precipitators. Some 70-90% of the total SO2 emission is bound to the clinker. The fish processing industry has invested $.84 million for odor control; while combined scrubbing and incineration would require another $11.9 million. The melting industry has invested $7.28 million for the control of dust emissions. The investments by the wood processing and pulp and paper industries run to $14 million.

55161

Pell, Eva J.

NINETEEN SEVENTY-TWO SURVEY AND ASSESSMENT OF AIR POLLUTION DAMAGE TO VEGETATION IN NEW JERSEY. Rutgers-The State Univ. New Brunswick, N. J., Dept. of Plant Biology, Environmental Protection Agency Contract 68-02-0078, EPA-R5-73-022, Program Element 1A1004, 45p., June 1973. 27 refs. NTIS: PB 223089

The economic impact of air pollution on New Jersey vegetation was studied from May 1972 through May 1973. Direct losses to agronomic crops and ornamental plantings were evaluated; crop substitution and indirect yield reduction were not accounted for. The total losses to these crops during the study period amounted to $128,019. Forty-seven percent of the plant damage was caused by oxidants, 18% by hydrogen fluoride, 16% by ethylene, 4% by sulfur dioxide, and 1% by anhydrous ammonia. Cumberland, Warren, Atlantic, and Salem Counties sustained the greatest damage. The damage reported in this survey was only 11% of that reported for New Jersey during the 1971-72 period. Reduced losses did not result from decreased air pollution concentrations but from altered environmental conditions. The unusual rainfall patterns in 1972 placed the plants under water stress and probably protected them from air pollution injury. In addition to evaluating crop losses, unknown problems were documented and research needs assessed. (Author abstract)

60298

Gillette, Donald G.

AGRICULTURAL LOSSES AND ASSESSMENT OF AIR POLLUTION DAMAGE. Preprint, Virginia Polytechnic I t., Blacksburg and Univ. of Puerto Rico, Rio Piedras (Puerto Rico), 14p., 1974. 11 refs. (Presented at the Air Pollution Workshops, Blacksburg, Va., March 4-6, 1974 and Rio Piedras, Puerto Rico, March 13-15, 1974.)

Estimated losses from air pollution damage to vegetation in the United States range from less than $100 million to more than $500 million per year, and approximately 80% of the estimated damage is attributed to oxidants. Damage from sulfur oxides and fluorides accounts for about 10%, and about 10% of the total loss can be charged to other miscellaneous pollutants. Over one-third of the total loss is associated with damages to ornamentals and shrubs in heavily polluted urban areas, while the remaining losses of approximately $100 million are incurred by commercial crops grown in urban fringe areas or around major rural point sources. Over half of the estimated vegetative losses from air pollution in the United States occur in the state of California. The opportunity costs incurred by farmers as a result of pollution infringement on their productive capabilities are extremely difficult to quantify because of the intangible nature of the value or cost of the opportunities lost.

67865

Benedict, Harris M., Clarence J. Miller, and Jean S. Smith

ASSESSMENT OF ECONOMIC IMPACT OF AIR POLLUTANTS ON VEGETATION IN THE UNITED STATES: 1969 AND 1971 (FINAL REPORT). Stanford Research Inst., Menlo Park, Calif., Coordinating Research Council Contract CAPA 2-68(1-71) CPA 70-16 and Environmental Protection Agency Contract 68-02-0312, SRI Proj. LSU-1503, Rept. EPA-650/5-73-002, 100p., July 1973. 46 refs. NTIS: PB 224818/AS

The economic impact of air pollutants on vegetation in the United States was assessed by selecting counties where major air pollutants such as oxidants, nitrogen oxides, sulfur dioxide, and fluorides were likely to reach plant damaging concentrations. Calculations for 1969 estimates indicated that 40% of the dollar value of agricultural crops, 36% of the value of forests, and over 50% of the ornamental value lie in polluted areas of the United States. Total annual dollar loss to crops in the United States was calculated to be about $87.5 million, with oxidants accounting for $77 million, SO2 accounting for $4.97 million, and fluorides accounting for $5.25 million. Applying loss factors to the 1969 crop data and adding the increase in crop values between 1969 and 1971 resulted in an estimated $123.3 million loss due to oxidants and an $8.2 million loss due to SO2 for the year 1971. The greatest percentage of crop losses on a regional basis occurred in the heavily populated and industrialized areas of the southwestern, middle Atlantic, and midwestern states.

76213

Champagne, Jean and Brian Sawyer

LONG-TERM PLANNING OF ENVIRONMENTAL PROTECTION IN ALUMINUM WORKS. (Planification a long terme pour la protection de l environnement dans les alumineries). Text in French. Preprint, Assoc. for Clean Air Maintenance, Quebec, 8p., 1975. (Presented at the Strategy of Air Management Conference, St-Jovite, Canada, May 25-27, 1975.)

Different alternatives for the long-term abatement of particulate and gaseous fluorine emissions in aluminum factories in Quebec are discussed. The complete reconstruction, i.e., the shutdown of obsolete plants, and the introduction of the most advanced technology, including dry filtration or electrostatic precipitation of particulate emissions, would require an investment of about $1,000,000,000. In the long run, this solution would reduce the energy use by 15%, and also the operating costs in general. Acceptable air quality could be achieved by the use of wet filtration techniques at an investment of $100,000,000 at a rate of $25,000,000 annually. Extended modernization, involving the introduction of dry filtration or electrostatic dust precipitation, would cost $300,000.000. These latter alternative solutions would bring about a 3% increase in the energy use, and another increase in the operating costs.

K. STANDARDS AND CRITERIA

03032

METHODS OF MEASUREMENT OF AIR POLLUTION. Metodi di Misura Dell'Inquinamento Atmosferico. Fumi Polveri (Milan) 6, (7-8) 217-21, 1966. It.

The Organ of Cooperation and Economic Development (O.C.D.E.) with its headquarters in Paris, decided in January 1957, to create a 'work group' to study the methods of measurement of atmospheric pollution. In 1963 a document was drafted by highly qualified specialists and technicians from all the member countries of (O.C.D.E.) and it dealt with the measurement of smoke, anhydrides of sulfur, sulfuric acid, hydrocarbons and fluorine. It is suggested that standard units of measurement be used, in the cgs system. Smoke and anhydrides of sulfur are measured in micrograms per cubic meter (O C, 760 mm Hg). A method of measuring smoke in the atmosphere consists of passing a volume of air through a filter and measuring a color change in the machine. A correlation is obtained between the material collected in the machine and the color change based on a 'standard smoke' measurement. Sedimentable materials are measured in milligrams per square meter per day. (Author summary)

03582

CALIFORNIA STANDARDS FOR AMBIENT AIR QUALITY AND MOTOR VEHICLE EXHAUST (TECHNICAL REPT.) (SUPPLEMENT NO. 2 ADDITIONAL AMBIENT AIR QUALITY STANDARDS). California State Dept. of Public Health, Berkeley. 28 pp., 1962.

Amended ambient air quality standards are tabulated. The basis for ethylene, hydrogen sulfide, and fluorides standards are received in terms of their effects on man, on vegetation, and on livestock. The 'adverse' level for ethylene was 0.5 ppm for 1 hr or 0.1 ppm for 8 hr (damage to vegetation) and for hydrogen sulfide, 0.1 ppm for 1 hr (sensory irritation). When forage crops containing 30 to 50 ppm of fluoride, measured on a dry weight basis, are consumed over a long period, teeth and bones of cattle may show changes, depending upon age, nutritional factors, and the form of fluoride ingested.

07605

Middleton, John T.

AIR QUALITY CRITERIA ASSOCIATED WITH VISIBILITY REDUCTION, SOILAGE AND DAMAGE TO VEGETATION. Preprint, California Univ., Riverside, Air Pollution Research Center, 14p., 1963. (Presented and Methods of Measurement, Geneva, Switzerland, Aug. 6-12, 1963. Paper No. WHO/AP/15.)

Particulate loading of the atmosphere is primarily responsible for reduction in visibility. The amount of visibility reduction, in turn, is due to the nature of the particle. The criterion for visibility is perhaps best given in terms of visible distance at a specific relative humidity. Air quality criteria for soilage may be developed where specific contaminants have direct effects upon particular materials. Since in general the soilage of goods is a function of multiple actions, air quality criteria for soilage are difficult of description and perhaps of lessened general utility. Air quality criteria for visible effects of vegetation damage can be developed for those toxicants which have direct effects, such as sulfur dioxide, ethylene, nitrogen dioxide, peroxyacyl nitrates, and ozone. Air quality criteria for fluorides cannot now be determined because of the multiplicity of factors which control the rate of accumulation and the subsequent effect of fluoride upon plant tissues. Levels of fluoride responsible for damage to livestock can be established and a criterion based on this is feasible.

08420

Brodovicz, Bey A.

AIR QUALITY CRITERIA FOR PENNSYLVANIA. J. Air Pollution Control Assoc., 18(1):21-23, Jan. 1968. 4 refs.

In late 1965 the Pennsylvania Air Pollution Commission appointed a Council of Technical Advisors to develop air quality criteria. Recently this Council set forth its recommendations for ten pollutants. The philosophy of the Council is expressed. The major difficulties and rationale are mentioned. The recommendations are given and the potential use of the criteria is also explained. The establishment of firm guidelines of air quality is based solely on consideration of effects both on health and aesthetics. The criteria are broken into two distinct groups; air basin average and single point measurement. The pollutants included: 1. Suspended particulates (total), 2. Settled particulates (total), 3. Lead (tentative), 4. Beryllium, 5. Sulfates (as H_2SO_4), 6. Sulfuric acid mist, 7. Fluorides (total soluble, as HF), 8. Sulfur dioxide, 10. Oxidants, 11. Hydrogen sulfide, and 12. Carbon monoxide.

10168

SANITARY STANDARDS FOR PLANNING INDUSTRIAL ENTERPRISES. In: A Collection of Most Important Official Items Related to Sanitary and Anti-Epidemiological (Prophylactic) Problems. An Aid to the State Sanitary Inspector-Physician and Physician-Epidemiologist. T. E. Boldyrev and V. M. Zhdanov (eds.), Vol. 2, 3rd ed., Moscow, State Publishers of Medical Literature, Medgiz, 1953, Chapt. 1, p. 113-148. Translated from Russian.

Standards are presented which apply to the improvement of existing industrial enterprises or the planning of new buildings with respect to the site of the enterprise, the nearby residential environment, the water supply source, and the manner of sewage disposal. Conditions prevailing in the territory of the planned enterprise must accord with the sanitary requirements with regard to precipitation, drainage, direct sunshine, natural ventilation, and level of ground water. Plans for the construction of plants must include provision for the health of thw workers, as well as the execution and maintenance of a sanitary clearance zone and the adequate planting of appropriate trees, shrubs, and other green plants. Requirements are indicated for various chemical processing plants, metal processing and machine construction industries, ore and mineral production, building industries, wood processing in-

dustries, textile industry, plants processing animal products, and food industries. Periodic physical examinations are recommended for workers exposed to lead and its organic compounds, ethylated gasoline, mercury and its compounds, manganese, chromic acid and its salts, arsenic compounds, phosphorus, cobalt, fluorine, sulfuric acid, chlorine, bromine, carbon bisulfide, hydrogen sulfide, crude oil and petroleum products, chlorinated and brominated hydrocarbons, and radioactive substances.

11414

K. Biersteker

FRESH AIR QUALITY STANDARDS. (Kwaliteitsnormen Buitenlucht.) Translated from Dutch. T. Soc. Geneesk., No. 46:166-176, 1968. 58 refs.

Fresh air quality standards in different nations are reviewed. Considerable differences exist because the hazards of air pollution are assessed differently. However, the differences in clean air specifications appear to disappear as the maximum permissible impurity concentrations become gradually lower. The Committee for Soil, Water and Air in Rotterdam developed standards which have no legal significance but help government and industry to establish clean air policies. These standards are tabulated for chlorine, hydrogen fluoride, carbon monoxide, ozone, nitrogen dioxide, sulfur dioxide, hydrogen sulfide and sulfuric acid--with comparable standards shown for West Germany, Russia, and the United States. The permissible SO2 concentration in California is higher than in Europe. This is due to the fact that SO2 plays a minor role in summer fog formation. In Europe, however, fog occurs in the winter and is accompanied by high SO2 and smoke concentrations. Another notable difference in air quality standards is that the Russians have unrealistically high standards for clean air while in Western Europe air is considered as a raw material which should be left in a reasonably good condition for the next consumer. Air quality directives, being used for the city of Rotterdam, and air pollution alarm systems used for Los Angeles and proposed for New York, are discussed.

13173

McCune, D. C.

THE TECHNICAL SIGNIFICANCE OF AIR: FLUORIDE CRITERIA FOR VEGETATION REFLECT THE DIVERSITY OF PLANT KINGDOM. Environ. Sci. Technol. 3(8):720-735, Aug. 1969.

Problem areas in the development of air quality criteria and the application of standards are (1) the nature and occurrence of the pollutant, (2) the effects of the pollutant on a receptor and the factors that determine the dose-response relationship, and (3) the characteristics of present air monitoring techniques. Atmospheric fluorides present specific problems in each area and illustrate problems of general significance with respect to the effects of air pollution on vegetation. Criteria, for example, can be established only for gaseous fluoride pollutants. However, if air quantity standards are to be meaningfully evaluated and enforced, monitoring techniques must be developed that can discriminate between particulate and gaseous forms. Soundly-based criteria and standards must also consider the temporal distribution of atmospheric fluorides. Unfortunately, not enough is known about the effects of fluorides on plants to allow the formulation of concentration, duration, and frequency parameters. It is doubtful that continuous function can describe the effects of fluorine under given biological and environmental conditions. A better method for presenting criteria is a dose- response surface for an effect of a certain degree and type in terms of the probability of its occurrence. If standards are to be useful, the art of determining fluoride levels must be refined. Acceptable standard monitoring methods may result from the work of the Halogen Subcommittee of the Intersociety Committee on Manual of Methods for Air Sampling and Analysis. Included is a discussion by R. H. Daines of the implication of standards for industrial plant design. Variations in plant sensitivity to fluorides are discussed by H. R. Hickey.

14772

Weaver, Neill K.

ATMOSPHERIC CONTAMINANTS AND STANDARDS. STATUS REPORT. J. Occupational Med., 11(9):455-461, Sept. 1969. 23 refs.

The Federal Air Quality Act of 1967 furnishes the methodology for the abatement of air pollution. Its provisions include the designation of air quality control regions and the issuance of air quality criteria and control technology documents, which will be followed by the promulgation of ambient air standards and emission standards at regional, state, and local levels. The atmospheric pollutants of current major concern are sulfur oxides, particulates, nitrogen oxides, hydrocarbons, oxidants, carbon monoxide, fluorine, and lead. Their toxic and other deleterious effects, exhibited at various concentration-time exposures, can be related to levels reached by the individual contaminants in the air of cities. While such an evaluation does not allow for possible interactions between pollutants, it appears that sulfur dioxide, oxidants, and carbon monoxide may be harmful to human health when the agents are concentrated, as in focal areas of emission or during sustained meteorologic inversions. Gains to be achieved by controlling these and other contaminants during non- peak conditions are probably derived from aesthetic, economic, and welfare benefits rather than health. Abatement procedures should eliminate rises in pollutant levels beyond the average ranges generally present in urban ambient air. (Author summary modified)

17375

Hodge, Harold C. and Frank A. Smith

AIR QUALITY CRITERIA FOR THE EFFECTS OF FLUORIDES ON MAN. J. Air Pollution Control., 20(4):226-232, April 1970. 42 refs.

Atmospheric and industrial concentrations of fluoride are considered, together with the effects of fluoride on man. Urban concentrations of fluoride range from less than 0.2 micrograms/cu m to 1.9 micrograms/cu m. Depending on the processes involved, factories using fluorides release to the atmosphere elemental fluorine (F2), soluble gaseous fluorides (HF), and soluble or insoluble fluoride dusts. Industrial air concentrations of fluorides range from a fraction of a milligram of fluoride per cu m to values mostly less than 10 mg/cu m. Average urinary F concentrations not exceeding 5 mg/l, which corresponds approximatel to a daily intake of 5 mg, are not associated with osteosclerosis in workmen. The amount of fluoride retained by an individual inhaling air containing 2.5 mg of fluoride dust per cu m (the current threshold limit value) is approximately 5-6 mg. The available evidence indicates that, with a few exceptions, the health of persons in the vicinity of factories emitting fluoride fumes or dust is not adversely influenced. However, some types of vegetation are highly susceptible to the effects of fluorides and an air quality standard to protect vegetation will be far lower than that encountered in the factory. If the standard is set at 10 ppb, the probable daily human intake would be 0.16 mg, which is far below the level required for the production of clear-cut effec in the human.

19750

Pennsylvania State Dept. of Health, Harrisburg, Air Pollution Commission

PENNSYLVANIA AMBIENT AIR QUALITY STANDARDS. 6p., Oct. 20, 1969. 10 refs.

Annual, 30-day, 24-hr and/or 1-hr air quality standards are given for 12 pollutants (suspended and settled particulates, lead beryllium, sulfates as H2SO4, sulfuric acid mist, fluorides as HF, sulfur dioxide, nitrogen dioxide, oxidants, hydrogen sulfide, and carbon monoxide) in accordance with the requirements of the Pennsylvania Air Pollution Control Act of 1960. These standards, which will be reviewed at least once a year, are for single-point measurements; they represent minimum, and not necessarily desirable quality. The 24-hr standard for SO2 is 0.10 ppm; for suspended particulates, 195 micrograms/cu m. An antidegradation policy is stated to the effect that where present air quality is significantly higher than the established standards, the difference will be conserved, based on a long range forecast of probable land and air uses in areas of high air quality. Sampling and analytical procedures to be employed for measuring ambient levels are specified for each of the 12 pollutants.

19818

LIST OF JAPANESE INDUSTRIAL STANDARDS ON AIR PURIFICATION AS OF MARCH 1970. (Kuki seijo ni kansuru JIS ichiranhyo. 1970 nen sangastsu genzai). Text in Japanese. Kuki Seijo (Clean Air - J. Japan Air Cleaning Assoc., Tokyo), 8(2):62-64, June 1970.

Japanese industrial standards listed under special alphabetical, four-digit codes include the following: methods for continuous measurement of carbon monoxide, carbon dioxide, and hydrocarbons in automotive exhausts; analysis of ammonia, nitrogen oxide, fluorides, chlorine, hydrogen chloride, hydrogen sulfide, and hydrogen cyanide in flue gas; polarography; conductivity; potential difference titration methods; gas chromatography; light absorption; infrared spectroscopy; granular activated charcoal; powdered activated charcoal; cokes; industrial gasoline; automotive gasoline; kerosine; light oils; heavy oils; airplane gasoline; jet fuels; liquefied petroleum gas; air filter oil metal corrosion experiment; quantitative analysis of lead anti-knock agent in gasoline; analysis of sulfur in petroleum products; kerosene stove; tests by Geiger-Muller counter; radiation survey meter; air filter for radioactive particulates, measurement of smoke and dust in flue gas; tests for airborne particulates (weight method by electrostatic dust-sample); and measurement of sterilizing ultraviolet light.

25933

INORGANIC FLUORIDES. Am. Ind. Hyg. Assoc. J., 30(1):98-101, 1969. 21 refs.

Inorganic fluorides are ubiquitous; they are found naturally in most soils, water, vegetation, and animal tissue. In the small amounts present, they produce no harmful effects and are considered by many nutritionists as essential minor elements. They are important as air pollution since excessive amounts can produce damage both in vegetation and in animals that consume contaminated forage. The fluoride content of forage should not exceed 40 ppm F as a yearly average, be in excess of 60 ppm F for more than two consecutive months, or in excess of 80 ppm F for more than one month. Values of gaseous fluorides suitable as an air quality guide for residential and agriculture areas are as follows: 4.5 ppb average for 12 hrs; 3.5 ppb average for 25 hrs, 2.0 ppb average for 1 wk; and 1.0 ppb average for 1 month.

26738

McCune, Delbert C.

ON THE ESTABLISHMENT OF AIR QUALITY CRITERIA, WITH REFERENCE TO THE EFFECTS OF ATMOSPHERIC FLUORINE ON VEGETATION. American Petroleum Inst., New York, Div. of Environmental Affairs, No. 69-3, 33p., Feb. 1969. 66 refs.

The significance of the form of airborne fluorides to air quality criteria is that the type of fluoride compound will determine its toxicity to plants, and available data upon which criteria can be established have as their basis the effects of gaseous fluorides. Air quality standards or air monitoring techniques that consider only the total fluoride cannot be justified by present air quality criteria. The identification or classification of an effect does not by itself solve the problem of what constitutes damage. Some of the problems in the interpretation of effects with respect to what could be called injury or damage are discussed for tomato, alfalfa, sorghum, corn, gladiolus, tree fruits, citrus, and conifers. It is apparent that there can be no single criterion for the effects of atmospheric fluorine on vegetation. The temporal distribution of atmospheric fluorine is another important factor in the evaluation of data or the selection of criteria. Precision, sensitivity, response time, and accuracy of air monitoring and analytical methods are also mentioned. The relevance of criteria to standards is discussed.

27010

Blokker, P. C.

COMMENTS ON AIR QUALITY STANDARDS IN DIFFERENT COUNTRIES. Stichting CONCAWE, The Hague (Netherlands), Document 2126, 12p., Sept. 1969. 17 refs.

A comparative survey is given (in tabular form) of maximum allowabl concentration values for oxidants, nitrogen dioxide, chlorine, hydrogen fluoride, sulfur dioxide, sulfuric acid, carbon monoxide, hydrogen sulfide, smoke, soot and dust in different countries in Europe and the U.S.A. In addition to the table for nitrogen oxides, the biological, phytotoxic, coloration, and photochemical smog effects of contaminant are discussed. The standards show important differences from country to country because their bases differ appreciably. For this reason the bases of the best known standards are summarized. These ar the standards of California, New York, Colorado, Rotterdam, West Germany, East Germany, and the U.S.S.R.

28466

Lebedev, Yu. D., M. K. Nedogibchenko, and L. F. Glebova

CERTAIN RESULTS AND IMMEDIATE PROBLEMS OF HYGIENE SCIENCE AND SANITARY PRACTICE IN THE AREA OF PROTECTING CITY AIR. (Nekotoryye itogi i blizhayshiye zadachi gigiyenicheskoy nayki i sanitarnoy praktiki v oblasti okhrany atmosfernogo vozdukha gorodov). Text in Russian. Gigiena i Sanit., 21(11):3-8, 1956.

Maximum allowable concentrations have been established for a number of air pollutants as follows (single and daily-average values, respectively, mg/cu m): sulfur dioxide, 0.50, 0.15; chlorine, 0.10, 0.03; hydrogen sulfide, 0.03, 0.01; carbon disulfide, 0.50, 0.15; carbon monoxide, 6.0, 2.0; nitrogen oxides, 0.50, 0.15; non-toxic dust, 0.50, 0.15; soot, 0.15, 0.05; phosphorus pentoxide, 0.15, 0.05; manganese and manganese compounds, 0.03, 0.01; fluorine compounds, 0.03, 0.01; sulfuric acid, 0.30, 0.10; phenol, 0.30, 0.10; arsenic (inorganic compounds other than arsine), 0.003; lead and lead compounds (other than tetraethyl lead), --, 0.0007; and metallic mercury, --, 0.0003. Major administrative and technical problems associated with air pollution control in 1956 are reviewed.

31968

Yamamoto, Norimasa

ON EMISSION STANDARD OF SMOKE (HARMFUL SUBSTANCES) BASED ON AIR POLLUTION CONTROL LAW. (Taiki osen boshiho ni motozuku baien -- yugai busshitsu -- no haishutsu kijin ni tsuite). Text in Japanese. Preprint, Smaller Enterprises Promotion Corp. (Japan) 72p., 1971. (Presented at the Public Nuisance Prevent. Tech. Seminar, Japan, 1971.)

Characteristics of smoke, dust collection equipment, average particulate diameter, and other factors are tabulated. The number of boilers in Tokyo, Osaka, and Kanagawa are compared. The emission standard for dust is 0.06 g/N cu m-0.20 g/N cu m for boilers and furnaces, in newly constructed installations, which utilize heavy oil as fuel. The average cadmium concentration at nine monitoring stations in 1969 was 0.020 micrograms/cu m. Environmental pollution due to heavy metals is also considered. At 0.1 ppm, the odor of chlorine can be detected with slight irritation; at three to six ppm, there is irritation of the eyes, nose, throat, and headache, while life is threatened at 14-21 ppm. Chlorine also damages plants after about 0.5 ppm. Chlorine, up to 0.5 ppm, is contained in tap water. The environmental standard should be less than 0.02 ppm. Even small amounts of fluorine in the atmosphere can damage plants, and the standard should be two to five micrograms/cu m. Above two to eight ppm of F, teeth have motley patterns, and eight to 15 mg/day for 10 years would bring about softening of the bone. Standards are also given for sulfur dioxide, carbon monoxide, oxidants, hydrocarbons, and nitrogen dioxide. Air pollution control agencies, districts, plans and alerts are mentioned.

33107

EXPLANATION OF DUST ETC. DISCHARGE STANDARD AS IN AIR POLLUTION CONTROL LAW ENFORCEMENT REGULATIONS. (Taiki osen boshiho seko kisoku ni miru baijinto no haishutsu kijunchi no kaisetsu). Text in Japanese. Kogai To Taisaku (J. Pollution Control), 7(7):588-590, July 1971.

In Japan, the emission standard for sulfur dioxide is based on diffusion formulas, according to a system of area allocations. The country is divided into eight ranks which represent from between 0 020 and 0.045 ppm maximum ground concentration of SO2, depending upon the degree to which the area has been industrialized. Old facilities must be equipped with electrostatic precipitators, bag filter, multicyclones, or other dust collection equipment, while even stricter standards exist for newly constructed buildings. Even in areas where fuel consumption will double, air pollution levels are to be reduced one-third their present amount in five years. If necessary, more rigid standards may be applied by prefectural governments. Emission standards exist for cadmium, chlorine, hydrogen chloride, fluorine, hydrogen fluoride, lead, and other harmful substances. Standards for fuels also exist, so that they cannot have a sulfur content higher than 1.0-1.5%.

34063

Ministry of International Trade and Industry (Japan) Dept. of Thermal Power

THE CONTENT OF AIR POLLUTION CONTROL LAW REVISIONS AND THEIR APPLICATIONS FOR ELECTRIC WORKS. (Taikiosen boshiho kaisei no naiyo to denki kosakubutsu ni okeru unyo). Text in Japanese. Karyoku Hatsuden (Thermolelectric Power Generation), 22(10):1107-1113, Oct. 1971.

The 1970 revisions of public nuisance related laws are discussed with regard to purpose, content, application, and enforcement. The range of toxic pollutants was expanded to include cadmium and its compounds, chlorine and hydrogen chloride, fluorine and hydrogen fluoride, bromine fluoride, lead and lead compounds, and nitrogen oxides. Boilers using gases containing more than 0.1% sulfur content, coke furnaces, mineral depositories, mineral conveyors, crushers, graters, and sifters were added to the list of soot and dust creating facilities. Hydrocarbons, lead compounds, and nitrogen compounds were added to the list of toxic automotive emission gases. Emission standards are determined as before by the K figures obtained by the stack gas dispersion formula; but the entire country was divided into classifications according to various K values ranging from 11.7 to 26.3 (maximum allowable concentration of sulfur oxides 0.020 - 0.045 ppm). Soot and other dust particulate emission standards were revised on a large scale. Among electric power generator boilers, heavy oil and gas boilers were classified into three groups: Maximum allowable emission is 0.1 g/N cu m for boilers with more than 200,000 N cu m/h capacity; 0.2 g/N cu m for boilers between 40,000 and 200,000 N cu m; and 0.3 g/N cu m for boilers with less than 40, 000 N cu m/h capacity. These compare with the former 1.0 g/N cu m uniform standard. For low grade coal boilers, the maximum allowable concentration is 0.8 g/N cu m, and for high grade coal boilers, 0.4 g/N cu. Sulfur oxides standards and toxic pollutant emission standards are reviewed by tables.

36823

Ministry of Health and Welfare (Japan), Dept. of Environmental Health

EMISSION STANDARDS OF STACK GASES (TOXIC MATERIALS) BASED ON THE AIR POLLUTION CONTROL LAW. (Taiki osen boshiho ni motozuku baien (yugai busshitsu) no haishutsu kijun ni tsuite). Text in Japanese. Taiki Osen Nyusu (Air Pollution News), no. 67:3-39, Nov. 1971.

Emission standards for various toxic materials in stack gases, based on the Air Pollution Control Law, are presented in tables. Items reviewed are the dust emission standard; average emissions and dust collection rates according to various types of furnaces and various types of dust creating installations; standards and average emissions for settling particles, suspended particulates, chlorine, and fluorides; and the epidemiological study of the influences of fluorides. The Japanese Air Control Law, WHO indexes, Forecast and Warning systems of New York City, the United States National Primary Secondary Ambient Air Quality Standards Federal Register, Air Pollution Emergencies Episode Criteria, and the E.P.A Federal Register are included. Also included in table forms are the records of Tokyo air pollution monitoring stations on suspended particulates; total emission quantity by pollutants and by sources; carbon monoxide saturation of hemoglobin and symptoms; influences on the human body of various toxic matter such as sulfur dioxide, sulfuric acid mist, nitrogen dioxide, ozone, and suspended particulates; nitric oxide and NO2 concentration in Tokyo; emission standards for lead and lead compounds; a review of lead emitting industries; total dust particles and the lead content in the main cities of Japan; lead emission standards in various countries, and the 1969 SO2 measurements in various controlled areas in Japan.

37472

THE SOUTH CENTRAL STATES: A DIVERSIFYING INDUSTRIAL ECONOMY SPAWNS POLLUTION PROBLEMS. Ind. Develop., 140(6):13-25, Nov./Dec. 1971.

Dozens of heavy industries. including steel mills, paper plants, and cement factories, have joined petrochemicals and food processing to bring a new image of diversification to the economy of the South Central states. To minimize pollution problems attending industrial development, Arkansas, Louisiana, Oklahoma, and Texas have each enacted programs to guard their air and water. The air and water quality standards in these states are given along with a summary of the tax incentives and low- interest financing programs for pollution control equipment and facilities. Air quality standards are included for smoke shade, incinerator emissions, particulates, sulfur dioxide, dust fall, sulfuric acid mist and/or sulfur trioxide, carbon monoxide, oxidants, hydrocarbons, odor, hydrogen sulfide, hydrogen fluoride, sulfuric acid plants, steam generators, boilers, effective stack height, and nitric acid manufacturing.

38197

Ministry of Health and Welfare (Japan), Public Nuisance Section

STANDARD OF SOOT AND DUST EMISSION (INJURIOUS SUBSTANCES) BASED ON AIR POLLUTION CONTROL LAW. (Taikiosen boshiho ni motozuku baien (ugai bussitsu) no haishutsu kijun ni tsuite). Text in Japanese. 69p., May 1971.

Standards of emission of soot and dust, cadmium and its compounds, chlorine and hydrogen chloride, fluorine and its compounds, and lead and its compounds are discussed. The emergency contamination level is mentioned. A summary of the report of the experts conference on the criterion of soot and dust emission includes standards of emission for newly established or existing facilities, the characteristics and collection rate of soot and dust at different emission sources, the consumption of fuel, the amount of soot and dust at six prefectures in 1969, and the standard of emission from the special facilities provided by ordinance. Concentrations in the air, effects on man, the standard value of concentrations in the ambient air or standards of emission were discussed fro Ca, Cl, HCl, F, and Pb. Emergency measures and alarm systems during an emergency in Los Angeles and New York discussed with relation to the Air Pollution Control Law.

41266

Mestitzova, M.

FLUORIDES (AS HF). In: Documentation of MAC in Czechoslovakia. Czechoslovak Commission for MAC, Prague, p. 76-80, June 1969. 21 refs.

Fluorides are less active than gaseous or liquid compounds of fluorine. Soluble salts are more toxic. The fluoride ion is a protoplasmic poison. Effects of chronic poisoning are anemia, fragility of bones, and dental changes. Maximum allowable concentrations in different countries range from 1.0 to 2.5 mg/cu m. The suggested MAC values for Czechoslovakia are 1 mg/cu m (mean) and 2 mg/cu m (peak). The findings of various investigators are noted.

41267

Mestitzova, M.

FLUORINE. In: Documentation of MAC in Czechoslovakia. Czechoslovak Commission for MAC, Prague, p. 81-82, June 1969. 4 refs.

Fluorine causes severe skin irritation and, when inhaled, causes lung edema. Maximum allowable concentrations in different countries range from 0.05 to 0.4 mg/cu m. The suggested MAC values for Czechoslovakia are 0.2 mg/cu m (mean) and 0.4 mg/cu m (peak). The findings of several investigators are noted.

41295

Mestitzova, M.

HYDROGEN FLUORIDE. In: Documentation of MAC in Czechoslovakia. Czechoslovak Commission for MAC, Prague, p. 93-95, June 1969. 11 refs.

Hydrogen fluoride has an irritating effect on mucosa, the breathing tract, and the skin. Adaption to short-term exposure does not occur. There is also increased fluorine excretion in the urine. Maximum allowable concentrations in different countries range from 0.5 to 2.0 mg/cu m. The suggested MAC values for Czechoslovakia are 1.0 mg/cu m (mean) and 2.0 mg/cu m (peak). The findings of various investigators are noted.

41682

Ryazanov, V. A. (ed.)

MAXIMUM PERMISSIBLE CONCENTRATIONS OF NOXIOUS SUBSTANCES IN THE ATMOSPHERIC AIR OF POPULATED AREAS. In: American Institute of Crop Ecology Survey of USSR Air Pollution Literature. A Second Compilation of Technical Reports on the Biological Effects and the Public Health Aspects of Atmospheric Pollutants. M. Y. Nuttonson (ed.), Vol. 11, Silver Spring, Md., American Institute of Crop Ecology, 1972, p. 1-5, Translated from Russian. (Also Izv. Akad. Med. Nauk SSSR, vol. 11:201-204, 1968.) NTIS: PB 209478

The maximum allowable concentrations approved by the Assistant Chief Public Health Physician of the USSR are listed. Maximum single and mean daily concentrations of 94 noxious substances are presented, including standards for nitrogen dioxide, aldehydes, aromatic and aliphatic hydrocarbons, ketones, ammonia, organic nitrogen compounds, alcohols, phosporus compounds, organic and inorganic acids, vanadium compounds, sulfur and organic sulfur compounds, manganese compounds, cyanates, arsenic compounds, chlorinated hydrocarbons, mercury compounds, soot, lead compounds, nontoxic dusts, sulfur dioxide, carbon monoxide, fluorine compounds, chlorine compounds, gasoline, and chromium compounds. Concentration limits for specific combinations of substances are also described.

42039

Japan Environmental Agency, Tokyo, Bureau of Atmospheric Safety

STRICT LOCAL EMISSION STANDARDS BASED ON AIR POLLUTION CONTROL LAWS. (Taiki osen boshiho ni motozuku uwanose haishutsu kijun joreishu). Text in Japanese. Sangyo Kogai (Ind. Public Nuisance), 8(6):34-50, June 1972.

Japanese local emission standards, based on air pollution control laws are discussed. By 1972 there were 13 Prefectures in which these standards were applied. New standards are given for cadmium, fluorine, lead, chlorine, hydrogen chloride, and dust. The Prefectures are Akita, Fukushima, Ibaragi, Gun-ma, Saitama, Kanagawa, Toyama, Mie, Osaka, Nara, Okayama, Ehime, and Niigata. The new standards were applied to hydrogen fluoride and silicon fluoride.

44310

Ministry of Health and Welfare, Tokyo (Japan), Dept. of Public Nuisance

DATA RELATED TO THE AIR POLLUTION CONTROL LAW MINISTRY ORDINANCES (NO. 3). POLLUTANTS STANDARDS SPECIFIED BY ORDINANCES. (Taiki osen boshiho seishorei kankei shiryo (no. 3). Jorei no yoru yagai busshitsu no kisei jokyo nado). Taiki Osen Nyusu (Air Pollution News), no. 69:2-11, March 1972.

Japanese local emission standards, based on air pollution control laws, are presented in tables. Standards for sulfur oxides, ammonia, chlorinated hydrocarbons, hydrogen cyanide, nitrogen dioxide, hydrogen sulfide, lead, zinc, sulfur dioxide, copper compounds, cadmium, cyanice compounds, phosphorus compounds, and hydrofluoric acid are presented for each Prefecture. The areas of central cities where sulfurless fuel should be used are discussed. The air quality standards of many countries for SO2 and dust concentrations are presented.

44377

Kato, Keiji

THE PRESENT POLLUTION CONTROL STANDARDS INDEXES (AIR POLLUTION). (Genjo ni okeru kogai kisei suchi (taiki kankei). Text in Japanese. Kagaku Kogyo (Tokyo), 23(9);1194-1202, Sept. 1972.

A general review is given on the air pollution control standards in Japan. Three categories of pollutants, sulfur oxides, particulates, and harmful substances, such as carbon monoxide, have been subjected to control, and the standards are established. The sulfur oxides emission standards are determined by an equation which consists of two factors, the effective stack height and a district dependent parameter K. The present K values of different districts vary from 7.01 to 18.7. The national environmental standard of particulates is stated by the following two conditions, the hourly average concentration for 24 consecutive hours must be under 0.10 mg/cu m, and the hourly concentration must be under 0.2 mg/cu m. The conditions for CO are: an hourly average for 8 consecutive hours under 10 ppm. The emission standards of other harmful substances, such as cadmium compounds, lead compounds, chlorine and hydrogen chloride, fluorine and fluoro compounds, are also listed.

46081

Kakunan, Taira

THE RECENT SITUATION OF REGULATIONS ON AIR POLLUTION. (Kogai kisei no doko, Taiki kankei). Text in Japanese. Sekiyu Gakkai-Shi (J. Japan Petroleum Inst., Tokyo), 15(7):601-605, July 1972.

The environmental criteria for sulfur oxides, carbon monoxide, and suspended particles 10 micron in grain size are discussed. One-hour averages for successive 24 hours should be 0.10 mg or lower per 1 cu m of the atmosphere; 1-hour values should be 0.20 mg per 1 cu m of the atmosphere. Lead, nitrogen oxide, hydrocarbon, and fluoride criteria are being set up. Sulfur oxides emission criteria were set up on Jan. 5, 1972. The new SOx criteria, are different by district such as 9.34 (K value) for Sapporo and Kokkaido, while they are 7.01 and 6.42 for Tokyo. Except for five over-congested areas, the criteria will have been met by some time in 1973. A nationwide survey of environmental and emission concentrations of SOx is planned for some time in 1973 to re-appraise effectiveness of the criteria and revise them if necessary. Regulations on fuel are presently enforced only in big cities, but the enforcement will cover more areas in the coming year. Not only the automotive emissions, but also other general sources of NOx emission should be considered in establishing the criteria. Studies are already underway. Dust emission criteria have been drastically strengthened effective June 1972.

47672

Stern, Arthur C.

AIR AND WATER POLLUTION QUALITY STANDARDS. PART I: AIR POLLUTION STANDARDS. In: Industrial Pollution Control Handbook. Herbert F. Lund (ed.), New York, McGraw-Hill, 1971, Chapt. 4, p. 4-1 to 4-22.

In general an air quality standard is developed by formally or informally considering air quality criteria, which are compilations of effects associated with various concentrations and durations of exposure of pollutants, plus other factors, such as cost and technological feasibility of emission control, and social questions. The Clean Air Act and the process involved in the adoption of air quality standards in the United States are outlined. Development and features of the air quality standards in the Soviet Union, Poland, West Germany, and other countries are indicated. State air quality standards are given for carbon monoxide, ethylene, fluorides, hydrogen sulfide, nitrogen dioxide, oxides of nitrogen, oxidants, sulfur dioxide, beryllium, calcium oxide, lead, sulfates, sulfuric acid, and suspended particulate matter. Standards which attribute to a source, and limit the emission from the source on this basis, are emission standards. The promulgation and features of the emission standards in the United States, Great Britain, the Federal Republic of Germany, Japan, and other countries are presented. Tables of both emission and air quality standards are included. Stack height and fuel standards are mentioned.

51057

Subcommittee on Permissible Concentrations (Japan)

DOCUMENTATION OF PERMISSIBLE CONCENTRATIONS OF HAZARDOUS SUBSTANCES IN WORKING ENVIRONMENT. (BASIS OF PROPOSAL). (Kyoyonodo to no kaisetsu (Teian riyu)). Sangyo Igaku (Jap. J. Ind. Health), 14(1):45-90, 1972. 429 refs. Translated from Japanese by Seizaburo Aoki, Japanese Language Translation Service, Fujisawa, 199p.

Permissible concentrations of hazardous substances in the atmosphere are documented for the years 1963-1970. The bases for the proposals are given for each substance. For 1963 substances included: sulfuric acid, hydrochloric acid, nitric acid, hydrogen sulfide, ozone, acetic esters, methanol, gasoline, arsenious acid, beryllium, cadmium oxide, selenium, pentachlorophenol, and trichloroethylene. Substances for 1964 include: hydrogen fluoride, bromine, methyl ethyl ketone, carbon tetrachloride, acetone, inorganic phosphorus; for 1965: organic lead, xylene, hydrogen arsenide, tolylene diisocyanate, methyl chloride, vinyl chloride, chloroform, tetrachloroethane, monoethanolamine, and industrial powder and dust causing pneumoconiosis. For 1966 the list includes: nitroglycol, ethyl ether, methyl isobutyl ketone, isopropyl alcohol, isoamyl alcohol, manganese, nickel carbonyl, ethylene oxide, dichloroethanes, methylene dichloride, chlorobenzene, orthodichlorobenzene, paradichlorobenzene, ethyleneimine, ethylenediamine, methylamine, normal hexane, cellosolve, cellosolve acetate, acrylonitrile, and vanadium; for 1967: nickel, ethyl chloride, dichloroethyl ether, butylamine, propyleneimine, zinc, and methylene-bis-phenyl isocyanate. the list for 1968 includes: iodine, phosgene, styrene, chloropicrin, and ammonia; for 1969: phosgene, toluene, butanol, zinc, and powder and dusts. The list for 1970 includes: amyl acetate, cyclohexane, cyclohexanol, cyclohexanone, and propyl acetate.

51212

MONTANA AIR QUALITY STANDARDS. Ind. Develop., 142(1):21-23, Jan./Feb. 1973.

Emission standards in Montana are presented for incinerators, visible emissions, industrial processes, fuel burning equipment, wood-waste burners, primary non-ferrous smelters, slag treat-

ment plants, kraft pulp mills, primary aluminum reduction plants, aluminum smelters, ponds, and aluminum manufacturing plants. Ambient air standards are given for smoke, sulfur dioxide, reactive sulfur, suspended sulfate, sulfuric acid mist, hydrogen sulfide, total suspended particulates, settled particulates, lead, beryllium, and fluorides. Emission rates based on process weight rates are given for particulate emissions. Ground-level sulfur oxide emission limits are also given.

51229

WYOMING AIR QUALITY STANDARDS. Ind. Develop., 142(1):31-32, Jan./Feb. 1973.

Emission standards in Wyoming are presented for visible emissions, particulate emissions from new and existing sources, wood waste burners, sulfuric acid mists, and fuel burning equipment. Maximum allowable concentrations are given for total suspended particulates, suspended particulates, sulfur oxides, sulfation, hydrogen sulfide, photochemical oxidants, hydrocarbons, nitrogen oxides, hydrogen fluoride, gaseous fluoride, and carbon monoxide. Emission rates based on process weight rates for particulates are given along with a formula to calculate emissions.

58638

Stokinger, H. E.

TOXICITY OF AIRBORNE CHEMICALS: AIR QUALITY STANDARDS--A NATIONAL AND INTERNATIONAL VIEW. Ann. Rev. Pharmacol., vol. 12:407-422, 1972. 22 refs.

Official air quality standards (AQS) for industry and community in the United States are discussed and compared to those in the USSR. The basis for AQS in the USSR is unknown. They have no limits for ethylene, iron oxide, hydrocarbons, particulates or photochemical oxidants. Their standards tend to be lower than in the U. S. In the U. S. there are considerable differences between the limiting concentrations of the threshold limit values (TLV) for industrial air with the AQS for community air. Depending upon the type of air pollutant, not only is the protection of human health and well-being considered, but foliage and crop damage, soiling, visibility reduction, and corrosion may ultimately be the prime determinants of AQS. Depending upon the specific basis on which the AQS ultimately rests, differential factors between AWS and TLVs may range from one half(ozone) to one hundredth (nitrogen dioxide, sulfur dioxide, iron oxide) to one thousandth (lead) or more (hydrogen fluoride). The scientific basis for the differences in the limited concentrations of the standards for community and industrial are discussed for carbon monoxide, SO2, NO2, hydrocarbons, O3, particulates, and lead.

58899

Fujiwara, M.

REGULATIONS AND CRITERIA FOR ATMOSPHERIC POLLUTION, WITH SPECIAL REFERENCE TO NOX AND LEAD. (Taiki osen no kisei to kijun, tokuni NOx to namari ni tsuite). Text in Japanese. Kankyo Kenkyu (Environ. Studies), no. 4:45-52, Oct. 1973.

Emission standards for sulfur dioxide, carbon monoxide, suspended particulates, nitrogen dioxide, oxidants, hydrocarbons, lead, and hydrogen fluoride are discussed. Emission standards for SO2 are 3 times as strict as those published the previous year. Automobile emissions constitute 93% of the CO, 40% of HC, and 39% of NOx total concentrations. Emission standards for 1975 cars limit CO to 2.1 g/km, HC to 0.25 g/km, and NOx to 1.2 g/km. A 5-year intermediate value for NO2 limits the daily 1-hour average concentration to 0.02 ppm for 60% of the days. Criteria for establishing standards for HC and Pb emissions are under consideration. Nitrogen oxides are regulated for boilers, furnaces in the petroleum and metallurgical industries, and sulfuric acid plants.

60180

Schulte, H. J.

MAXIMUM ALLOWABLE EMISSION CONCENTRATIONS FOR 20 SUBSTANCES. TARGET CONCENTRATIONS FOR THE AIR. (Maximale Immissions- Konzentrationen fuer 20 Stoffe erarbeitet. Zielwerte fuer die Luft). Text in German. Umwelt (Duesseldorf), 3(6):37-38, 1973.

The term maximum allowable emission concentration is defined, and the new maximum allowable emission concentrations worked out for 20 substances are listed in a table. For carbon monoxide the maximum allowable average emission concentration over 24 hours is 10 mg/cu m; for lead 0.002; for sulfur dioxide 0.3; for sulfuric acid 0.1; for nitrogen dioxide 0.1; for nitric oxide 0.5; for nitric acid 0.1; for ammonia 1.0; for hydrogen fluoride 0.1; for sodium fluoride 0.2; aluminum fluoride 0.3; for cryolithe 0.3; for calcium fluoride 0.5; for ozone 0.05; for airborne dust of less than 10 micron 0.1; for zinc 0.1; for tetrahydrofuran 60; for trichloroethylene 5 mg/cu m; and for methylene chloride 50 mg/cu m. For cadmium only an annual average standard has been set which is less than 0.00005 mg/cu m.

60887

Favorite, Frank G., Lawrence M. Roslinski, and Ralph C. Wands

GUIDES FOR SHORT-TERM EXPOSURES OF THE PUBLIC TO AIR POLLUTANTS. National Academy of Sciences-National Research Council, Washington, D. C., Advisory Center on Toxicology, Aerospace Medical Research Laboratory Contract F33615-70-C-1046 and Air Pollution Control Office Contract CPA 70-57, Proj. 6302, AMRL-TR-71-120, Paper 16, 6p., Dec. 1971, 1 ref. (Presented at the Systemed Conference on Environmental Toxicology, Annual Meeting, 2nd, Fairborn, Ohio, 1971.) NTIS, DDC: AD-751 438

Short Term Public Limits (STPL) and Public Emergency Limits (PEL) were defined for nitrogen dioxide, hydrogen chloride, and hydrogen fluoride. Nitrogen dioxide as a freely diffusible gas has the capacity to cause adverse health effects as a deep lung irritant at high concentrations (several hundred ppm for a few minutes) that might lead to pulmonary edema. Many variations in toxicity patterns occur with NO2: toxicity is enhanced in the presence of ozone, sulfur dioxide, aldehydes, and a high density of respirable particles. The ambient temperature and the age of the exposed person also markedly influence individual response. The following short-term limits are recommended: STPL--10 min, 1 ppm, 30 min, 1 ppm, and 60 min, 1 ppm; PEL--10 min, 5 ppm, 30 min, 3 ppm, and 60 min, 2 ppm. Depending on the severity of exposure, the physiological responses to the inhalation of irritating levels of HCl are coughing, pain, inflammation, edema, and desquamation in the upper respiratory tract. If concentrations are high enough, acute irritation may bring about constriction of the larynx and bronchi, closure of the glottis, and breath holding. Fatal inhalation of HCl would be expected only when the victim is unable to escape from the contaminated atmosphere. The following limits are recommended: STPL--10 min, 4 ppm, 30 and 60 min, 2 ppm, and 5 hr/day, 3-4 days/mo, 0.67 ppm; PEL--10 min, 6.7 ppm, and 30 and 60 min, 3.4 ppm. The primary effect of acute exposure to gaseous HF in concentrations above a few ppm is irritation to the skin, eyes, and

respiratory passages. Localized tissue damage may result on exposure to concentrations above recommended limits. At 12 ppm the mucosa are irritated, at 30 ppm for about 3 min the gas is detectable by taste, at 60 ppm the severity of irritation is noticeably increased, and at 120 ppm a stinging sensation of the skin is added, and the other irritations become so intense that man is unable to withstand the exposure for more than one min. The following limits are recommended: STPL--10, 30, and 60 min, 4 ppm, 5 hr/day, 3-4 days/ mo, 1 ppm; PEL--10 min, 10 ppm, 30 and 60 min, 5 ppm.

66860

Quarles, John

STANDARDS OF PERFORMANCE FOR NEW STATIONARY SOURCES. PROPOSED RULE FOR PRIMARY ALUMINUM PLANTS. Federal Register, 39(206): 37730-37741, Oct. 23, 1974.

Standards of performance for new and modified primary aluminum plants are proposed. The proposed standards do not differentiate between primary and secondary emissions and encourage owners of new plants to obtain maximum containment of the gaseous emissions at the cell. Two types of control devices will be used: wet gas scrubbers in series with an electrostatic precipitator or dry fabric filters which use alumina as an adsorbent. Gases discharged into the atmosphere from the potroom cannot exhibit 10% opacity or greater and those from the anode bake plant cannot exceed 20% opacity. Gases cannot be discharged which contain total fluorides in excess of 1 kg/metric ton of aluminum produced. Procedures and methods for testing and monitoring are specified.

66916

Quarles, John

STANDARDS OF PERFORMANCE FOR NEW STATIONARY SOURCES. FIVE CATEGORIES OF SOURCES IN THE PHOSPHATE FERTILIZER INDUSTRY. Federal Register, 39(205):37602-37607, Oct. 22, 1974.

Standards of performance for five categories of sources within the phosphate fertilizer industry are proposed. The sources are wet process phosphoric acid plants, super-phosphoric acid plants, diammonium phosphate plants, triple superphosphate plants, and granular triple superphosphate storage facilities. The standards require installation of high efficiency gas scrubbers. Construction of both of the more common processes for manufacture of superphosphoric acid is permitted even though one also emits pollutants other than fluorides (sulfur dioxide and hydrocarbons). Visible emsission standards are proposed for diammonium phosphate plants, triple superphosphate plants, and granular triple superphosphate storage facilities. The effluent gas streams from these processes include particulate matter (both fluoride and non-fluoride), as well as gaseous fluoride. The possible odor environmental impact was determined to be negligible.

67267

McCune, Delbert C.

ON THE ESTABLISHMENT OF AIR QUALITY CRITERIA, WITH REFERENCE TO THE EFFECTS OF ATMOSPHERIC FLUORINE ON VEGETATION. Boyce Thompson Inst. for Plant Research, Yonkers, N. Y., American Petroleum Inst., Air Quality Monograph 69-3, 36p., 1969. 66 refs.

The establishment of air quality criteria for atmospheric fluorine is considered, with particular reference to the pollutants effect on vegetation. The problem of formulating criteria for ambient airborne fluorine is complex since the sequence of fluoride exposure may outweigh the influence of the actual fluoride level within a fumigation concentration range of 0.5-10 micrograms F/cu m. There can also be no single criterion for the effects of atmospheric fluorine on vegetation owing to the differences among plants in their susceptibility to fluorine and consequence of fluorine-induced effects. The form of atmospheric fluoride is also a factor that determines its phytotoxicity, and air quality standards or air monitoring techniques that consider only the total fluoride cannot be justified by present air quality criteria. The temporal distribution of atmospheric fluorine is another important factor in the evaluation of data or the selection of criteria; models for airborne fluorine are not yet derived or tested, and the relationships of peak values, sampling or averaging periods, and mean values are not known.

68224

Wilcox, Sandra L., Edwin L. Keitz, and Linda J. Duncan

ESTABLISHING SAFE AMBIENT AIR QUALITY LEVELS FOR EIGHTEEN HAZARDOUS POLLUTANTS. Preprint, World Health Organization, New York, 6p., 1974. (Presented at the World Health Organization International Symposium, Paris, France, June 1974.)

Average safe 24-hour levels for 18 hazardous air pollutants are reported based on investigations conducted by personal contact with 23 recognized experts in the epidemiology of air pollution from the medical and public health professions. The average experts 24-hour levels in micrograms/cu m are as follows: arsenic, 5.9; barium, 77.5; beryllium, .005; boron, 50; cadmium, 1.2; chromium, 4.6; copper, 10; fluorides, 47; lead, 4.7; manganese, 11.4; mercury, 0.8; nickel, 3.7; selenium, 5.4; tin, 13.7; vanadium, 6.8; and zinc, 34. The average safe level for asbestos is .05 fibers/ml. Comparisons are made among the tonnage of pollutant emitted, the population in areas adjacent to the major emitter, and the safe ambient air quality level in order to indicate priorities which should be established for research and development of control technology for these pollutants. Safe ambient air quality levels are also compared with typical air quality levels to indicate relative priorities.

68582

Brun, M.-J. and P. Jarrault

MAXIMUM ALLOWABLE CONCENTRATIONS AND EMISSIONS LIMITED FOR INDIVIDUAL POLLUTANTS, INDUSTRIES, AND COUNTRIES ACCORDING TO STANDARDS AND RECOMMENDATIONS. (Teneurs limites dans l air ambient et a l emission. Valeurs par polluant, par industrie, par pays d apres les normes et recommendations). Text in French. C.I.T.E.P.A. Technical Interprofessional Study Center for Air Pollution, Etudes Documentaires 42, CI 805, CI 809, 53p., Feb. 1, 1974.

Maximum allowable concentrations and emissions from different sources of dust, sulfur dioxide, carbon monoxide, hydrogen sulfide, nitrogen oxides, chlorine, hydrochloric acid, fluorine, hydrocarbons, and heavy metals, as recommended or imposed by acts or standards in various countries, such as Bulgaria, Belgium, Canada, U.S.A., Finland, France, the Netherlands, Israel, Italy, Japan, West Germany, East Germany, Rumania, Sweden, Czechoslovakia, Turkey, and the USSR are listed. Percentages of the times during which the maximum allowable concentrations may be exceeded are given. Detailed listings are presented of the maximum allowable emissions from various sources, such as the metallurgical, chemical, and pulp and paper industries, waste incineration, domestic heating, cement works, petroleum refining, power generation, and surface treatment.

69550

Bisselle, C. A., S. H. Lubore, and R. P. Pikul

NATIONAL ENVIRONMENTAL INDICES: AIR QUALITY AND OUTDOOR RECREATION. Mitre Corp., Washington, D. C., Council on Environmental Quality Proj. 1910, MTR-5169, 262p., April 1972. 60 refs.

Separate indices of air pollution and outdoor recreation were formulated and computed for selected cities in the United States. Guidelines for implementation of an operational data collection and reporting system to allow routine computation of these indices are described. There was a general decline in the percent of cities exceeding standards on a national basis for sulfur dioxide and nitrogen dioxide. The percentage of cities with a total suspended particulates problem increased from 1968 to 1969 and declined only slightly in 1970. The nitrogen dioxide and total suspended particulates problem is far more severe and extensive than the sulfur dioxide problem, based upon present National Ambient Air Quality Secondary Standard values. The northeast region contributes the largest percent to the total value of the National index. The inclusion of photochemical oxidants for western cities or carbon monoxide for major cities would alter this depiction. The effects of contaminants such as fluorides, lead, cadmium, pesticides, and other toxic airborne substances require further studies and monitoring.

71991

Subcommittee on Air and Water Pollution

AUTOMOBILE EMISSIONS STUDY. In: Decision of the Administrator of the Environmental Protection Agency Regarding Suspension of the 1975 Auto Emission Standards, Part 2. 93rd Congress (Senate), First Session, Serial 93-H9, p. 465-470, May 14, 17, 18, and 21, 1973. 5 refs. (Hearings before the Committee on Public Works.)

An elaboration of the Environmental Protection Agency s reply to the automotive industry concerning criticism of the automotive emissions standards is presented. Topics covered include: criteria for establishing air quality standards and emission standards, the effects of automobile emissions on humans and vegetation, commercial engines that meet federal standards, an analysis of the American auto manufacturers approach to emission control, the balance of costs versus gains to the public resulting from automotive emission standards, and the systems analysis approach for determining appropriate trade-offs in emission control. Human health effects are tabulated for ozone, nitrogen oxides, sulfur dioxide, carbon monoxide, hydrocarbons, and particulates. Vegetation effects are summarized for SO2, O3, fluorides, ethylene, and nitrogen dioxide.

72145

Japan Environmental Agency

DEVELOPING BASIC MEASURES FOR ENVIRONMENTAL PROTECTION. In: Quality of the Environment in Japan. p. 210-212, 1974.

The establishing and tightening of environmental air quality standards in Japan are described. Environmental standards exist for sulfur dioxide, carbon monoxide, suspended particulate matter, nitrogen dioxide, and photochemical oxidants. Standards for hydrocarbons are scheduled for 1974. Consideration will be given to environmental standards for lead and fluorine compounds, and consideration of environmental standards for aldehydes and vanadium will be initiated. Future environmental standards will consider protection of the entire living environment, including preventing damage to plant life. Environmental impact assessment techniques will be developed and include urban air pollution.

72151

Japan Environmental Agency

EMISSION STANDARDS (APPENDIX 2). In: Quality of the Environment in Japan. p. 245-251, 1974.

The emission standards in Japan are presented for sulfur oxides, soot and dust, harmful substances, nitrogen oxides, odors, and motor vehicles. Sulfur oxide emission standards vary according to the region, and are tabulated for seven areas. There are special standards for newly constructed facilities. The soot and dust standards are listed for boilers, incinerators, and furnaces. At all facilities the standards for cadmium and its compounds is 1.0 mg/cu m N, 30 mg/cu m N for chlorine, and 80 mg/cu m N for hydrogen chloride. The standards for fluorine, hydrogen fluorine, silicon fluoride, lead, and nitrogen oxides vary by type of facility. Regulatory standards are listed for these odors: ammonia, methyl mercaptan, hydrogen sulfide, dimethyl sulfide, and trimethylamine. Exhaust emission standards are tabulated for carbon monoxide, hydrocarbons, and nitrogen oxides from trucks and automobiles.

74109

Osaka Prefecture, Div. of Life Environment (Japan)

DATA PERTAINING TO ESTABLISHMENT OF REGULATIONS ON EMISSION STANDARDS ACCORDING TO PROVISIONS OF ATMOSPHERIC POLLUTION CONTROL LAW, ARTICLE 4, ITEM 1, AND ON WASTE WATER STANDARDS ACCORDING TO PROVISIONS OF WATER QUALITY DETERIORATION CONTROL LAW, ARTICLE 3, ITEM 3. (Taiki osen boshiho Dai 4-jo, Dai 1-ko no kitei ni yoru haishutsu kijun oyobi suishitsu odaku boshiho Dai 3-jo, Dai 3-ko no kitei ni yoru haisui kijun o sadameru jorei no kaisuru shiryo). Text in Japanese. 25p., Feb. 1974.

The atmospheric emission (smoke) standards and waste water quality standards established by Osaka Prefecture, Japan, in accordance with key provisions of the Atmospheric Pollution Control Law (Law 97, 1968) and the Water Quality Deterioration Control Law (Law 138, 1970), are listed in tabular form. These standards are more stringent than those established by Law 97 and Law 138, and go into effect in 1974, with some extensions granted to 1976, for attaining waste water standards. Smoke emission standards are determined by maximum volume of exhaust gas emission per hour from the source (under 10,000 cu m; under 40,000 cu m; over 40,000 cu m corrected to O C and one atmosphere pressure) and by type of fuel (coal; heavy oil or other liquid fuel; and gas). Temporary excesses (not over 6 min/hr) in emission during ignition and cleaning procedures are not included in the effective emission levels. Allowable weights of smoke particulates per 1 cu m of exhaust gas range from 0.05 g to 0.40 g. Industrial waste water standards apply to five water basins and one coastal construction area. Waste water standards are also established from human waste and residential sewage treatment plants in Osaka Prefecture. For all types of waste water the range of pH is 5.8-8.6. Other water pollutant standards vary with data of plant construction (for industry), and type of treatment installation and population density (for residential sewage and human waste). The average daily BOD (biological oxygen demand) and SS vary from 20-120 mg/l, with allowable maximum of 150 mg/l for some industries. Average daily coliform count should be 3000 colonies/cu cm in industrial waste water. Cyanides and organic phosphorus compounds are not to be present in industrial waste water in analyzable amounts. Other controlled substances are cadmium, lead, chronium, arsenic, zinc, soluble iron and manganese, fluorine, phenol, and n-hexane extracts.

78880

Giese, H. J.

INCINERATORS FOR MEDICAL WASTES. (Verbrennungsanlagen fuer Medizinabfaelle). Text in German. Wasser Luft Betrieb, 19(4):171-174, 1975.

General hygienic and environmental requirements imposed on incinerators for medical wastes in West Germany are outlined. Medical wastes must be incinerated without any infection hazards for the incinerator personnel and for the environment. Wastes from hospital wards of infectious diseases have to be sterilized before incineration. The temperature of the afterburning chamber of the waste incinerator must be at least 800 C. Cyclones and wet type dust separators are best for incinerator flue gas cleaning. At a flue gas oxygen content of 17%, the dust concentration is limited to 100 mg/N cu m. The hydrochloric acid and hydrofluoric acid emissions are limited to 6 kg/hr and 0.2 kg/hr, respectively, which values are generally not exceeded in incinerators with throughput capacities of up to 750 kg/hr.

79255

McCutchen, Gary D.

NEW SOURCE PERFORMANCE STANDARDS, PRESENT AND FUTURE. In: Air Pollution Control and Industrial Energy Production. Kenneth E. Noll, Wayne T. Davis, and Joseph R. Duncan (eds.), Ann Arbor, Mich., Ann Arbor Science, 1974 (?), Chapt. 2, p. 5-40. 60 refs.

The legislative history of new source performance standards (NSPS) is reviewed. These standards are expected to play an important role in maintaining air quality, preventing significant deterioration, controlling noncriteria pollutants, and hastening the development and application of control technology. The Environmental Protection Agency has promulgated NSPS for twelve source categories, and standards for a total of approximately 40 categories are expected to be promulgated or proposed by the end of 1975. Standard-setting priorities will be based on the expanded role envisioned for NSPS. Nitrogen oxides and hydrocarbon sources, emerging industries, and large sources are considered important. New Source Performance Standards encourage the improvement of existing control technology and radically new approaches to air pollution problems. Control of stationary sources may consume less energy than would be used to counter the effects of that pollutant in the atmosphere. The EPA proposes to further strengthen NSPS by seeking authority to set equipment standards when emission standards prove impractical, and to provide for exceptions to the NSPS for facilities attempting pioneering research in control techniques. New Source Performance Standards can significantly reduce air pollution emissions by requiring the best control of new facilities. They appear to constitute the preferred approach to control of fluorides, and may also be utilized for lead and other pollutants.

80854

Ishida, Hitoshi

PRESENT STATE OF AIR POLLUTION AND ITS REGULATION IN JAPAN. Environment Agency (Japan), Air Pollution Control Div., World Energy Conf., 9th, Detroit, Mich. 1974, p. 1-23. (Sept. 22-27.)

A review of the present state of air pollution and its regulation in Japan is presented. Sulfur dioxide pollution which reached a peak around 1967 and 1968 appears to have levelled off and may be decreasing. Dust fall in major cities has significantly decreased since around 1960 as a result of a nationwide energy switchover from coal to oil and the installation of industrial dust control devices. Suspended particulate concentrations are still relatively high, though they do not appear to be increasing. Nitrogen oxide levels are steadily increasing in the absence of effective controls. Decreases in carbon monoxide levels in urban areas appear to be associated with automobile exhaust emission controls. Hydrogen fluoride, hydrogen chloride, chlorine, and photochemical oxidants are among pollutants which are showing increasing levels in certain urban areas. Ambient air quality standards are established for sulfur dioxide, carbon monoxide, suspended particulates, nitrogen dioxide, and oxidants. Emission standards are set for sulfur oxides, soot and dust, cadmium compounds, chlorine, hydrogen chloride, fluorides, lead compounds, and nitrogen dioxide. A total of 15 national air sampling networks are established throughout the country. (Author summary modified)

81864

Office of Air and Waste Management, Research Triangle Park, N. C., Emission Standards and Engineering Div.

BACKGROUND INFORMATION FOR STANDARDS OF PERFORMANCE: PRIMARY ALUMINUM INDUSTRY. VOLUME 3: SUPPLEMENTAL INFORMATION. Rept. EPA-450/2-74-020c, 50p., Jan. 1976. 4 refs. NTIS: PB 250667/AS

Background information dealing with performance standards for primary aluminum plants is presented. The information includes comments to proposed regulations and Environmental Protection Agency responses to these comments, updated economic impact data, and problems encountered with source sampling procedures. Growth in total domestic primary aluminum capacity and supplies is not expected to be adversely affected by the promulgated standards. The standards are estimated to require an investment cost increase at new primary aluminum plants amounting to about $95/ton of capacity (first quarter of 1975) or approximately 8% of the cost of a new uncontrolledd plant. Fluoride emission reductions resulting from the standards are expected to be about 48 lb of fluoride/ton of aluminum produced (96%) for uncontrolled plants and 11 lb/ton (85%) for plants employing the industry s current average level of control.

84395

Beck, David A.

PROPOSED STANDARDS OF PERFORMANCE FOR THE PRIMARY ALUMINUM INDUSTRY. Preprint, Air Pollution Control Assoc., Pittsburgh, Pa., 6p., 1975. 3 refs. (Presented at the Air Pollution Control Association, Southern Section, Annual Meeting, 6th, Nashville, Tenn., Sept. 17-19, 1975.)

Proposed standards of performance for the primary aluminum industry are reviewed. As a result of testing the best controlled existing primary aluminum plants, the Environmental Protection Agency is proposing an emissions standard of 2.0 lb of total fluoride/ton of aluminum produced. This means that the sum of the primary and secondary emissions (and the anode bake plant emissions for prebake facilities) must not be greater than 2.0 lb of total fluoride/ton of aluminum produced. Opacity standards of 20% for anode bake plant emissions and 10% for potroom emissions are also proposed. The standards are designed to force the best demonstrated control technology without adversely affecting the economy of the industry.

L. LEGAL AND ADMINISTRATIVE

06349

AMBIENT AIR QUALITY OBJECTIVES - PART 500 (STATUTORY AUTHORITY: PUBLIC HEALTH LAW. 1271, 1276). New York State Air Pollution Control Board, Albany, Dec. 11, 1964, 11 pp.

Ambient air quality objectives are tabulated for various pollutants. The objectives vary according to subregions which are determined by land use. Included is a list of references for the sampling and analytical methods employed in the measurement of particulates, sulfur dioxide, hydrogen disulfide, fluorides, beryllium, oxidants, carbon monoxide, and sulfuric acid mist.

06734

COMMONWEALTH OF PENNSYLVANIA, DEPARTMENT OF HEALTH, AIR POLLUTION COMMISSION, AMBIENT AIR QUALITY CRITERIA. 90th Congress 'Air Pollution--1967, Part IV (Air Quality Act)' Senate Committee on Public Works, Washington, D.C., Subcommittee on Air and Water Pollution, May 15-18, 1967.) p. 2396-7.

Ambient air quality criteria are tabulated as set forth in section 5 (f) (8) of the Pennsylvania Air Pollution Control Act of January 8, 1960, P.L. 2119. These criteria were adopted on April 25, 1967 by the Air Pollution Commission. Included in the tabulation are: particulates, lead, beryllium, fluorides, sulfur dioxide, carbon monoxide, and others. References are provided for the sampling and analytical methods employed for each pollutant.

06754

(EXCERPTS FROM THE ANNUAL REPORT FOR 1964 OF THE STATE INSTITUTE FOR THE PRESERVATION OF CLEAN AIR AND AGRICULTURAL LAND.) Aus dem Jahresbericht 1964 der Landesanstalt fur Immissions- und Bodennutzungsschutz. Reinhaltung der Luft im Land Nordrheim-Westfalen (3) 39-48, 1965. Ger.

A survey was made of the activities of an agency of the State of North Rhine-Westfalia concerned with air pollution problems. Air pollution control programs are described, in particular the first, second, and third program for measuring SO2 and dust concentrations. Instrumentation for measuring SO2, F, H2S, NO2, and NH3 is mentioned. Some practical results of reducing the emission in various industrial plants are presented, mostly of the metal and coal-using industries. Extensive experiments have been made to determine harmful effects of air pollutants on plants. A list of plants ordered according to their susceptibility is given.

06938

Florida Air Pollution Control Commission

RULES OF THE FLORIDA AIR POLLUTION CONTROL COMMISSION. (Administrative Procedures, Chapt. 28-1; General Rules, Chapt. 28-2; Air Pollution--Prevention--Control, Chapt. 28-3; and Permits, Chapt. 28-4) 10p., Jan. 20, 1965.

These regulations cover: hearing procedures, violations; complaints; quantities of fluoride injurious to cattle and gladioli; emission standards for fluorides, construction of new emission sources or addition to existing installations; and permits.

06939

RULES OF STATE BOARD OF HEALTH (THE SANITARY CODE OF FLORIDA - AIR POLLUTION - CHAPTER 180C-9). Florida State Board of Health, Jacksonville. (Supp. 27), 101-2A (Oct. 6, 1965).

A compilation is presented of rules enacted to eliminate, prevent, and control air pollution in Florida. Coverage includes visible emissions, particulate matter, fluoride emissions, power plants, and sampling and analysis of emissions. Maximum allowable particulate discharge is tabulated.

09677

Public Health Service, Washington, D. C., National Center for Air Pollution Control

A COMPILATION OF SELECTED AIR POLLUTION EMISSION CONTROL REGULATIONS AND ORDINANCES. (REVISED EDITION.) 142p., 1968.

This compilation contains selected sections of many emission con- trol regulations and ordinaces. It has been prepared to provide state and local air pollution control agencies, industries, and other interested people with selected examples of the many types of regulations and ordinances in use today. All sections of regula- tions and ordinances included have been copied directly from the original text of individual state and local laws. The regula- tions and ordinaces have been arranged in such a manner that each section of this report is a compilation of laws pertaining to a specific type of pollutant or pollutant source. These sections include Smoke Emissions and Equivalent Opacity Regulations, Particulate Emissions from Fuel Burning Plants, Particulate Emissions from Refuse-burning equipment, Particulate Emissions from Manufacturing Processes, Particulate Emissions from Asphalt Batching Plants, Sulfur Compound Emissions, Organic Solvent Emissions, Hydrocarbon Emissions, Fluoride Emissions, Motor Vehicle Emissions, Odor Emissions, and Zoning Ordinances. The regulations and ordinances compiled were selected to represent the different methods of controlling emissions by law and to represent varying degrees of control.

17188

Hashimoto, Michio

STATUS OF AIR POLLUTION BY NOXIOUS AND OFFENSIVE GASES AND THEIR CONTROL PROGRAMMES. (Yugai gasu to niyoru oen no genjo to sono taisaku ni tsuite). Text in Japanese. Kogai to Taisaku (J. Pollution Control), 2(7):441-444, Aug. 15, 1966.

A procedure for the adequate control of noxious gases, some of which are not yet covered by legislation, is discussed. Though dust fall is decreasing as a consequence of regulatory control, noxious and offensive gases are increasing in many in-

dustrial areas. The Labor Standard Law of 1947 provides for the control of working environments in the interest of worker health, but is no longer consistent with the present state of industrial pollution which poses a hazard for persons living in the vicinity of plants. The 1948 law regulating agricultural chemicals is concerned only with preventing injuries to people and livestock caused by the unrestricted use of chemicals; it does not consider the contribution of the chemicals to air pollution. High pressure gas control, fire prevention, mining, and other laws are subject to the same criticism. What is characteristic of these control laws is that they do not specify total noxious gas emission nor the relationship between a gas and its effect. The Smoke Dust Control Law is intended to compensate for these shortcomings; it now deals with sulfurous gas, anhydrous sulfuric gas with hydrogen fluoride, hydrogen sulfide, selenium oxide, hydrogen chloride, nitrogen dioxide, sulfur dioxide, hydrogen cyanide, carbon disulfide, ammonia, phosgene, and silicon tetrafluoride. More offensive gases are to be covered by the law.

17472

Duemmler, Friedrich

THE ANTI-AIR POLLUTION ACTIVITIES OF THE TECHNISCHE UEBERWACHUNGS-VEREIN. (Die Technischen Ueberwachungs-Vereine im Dienste des Immissionsschutzes). Text in German. Tech. Ueberwach (Duesseldorf), 10(10):339-345, Oct. 1970.

One of the most important tasks of the Technische Ueberwachungs-Verein (TUV) is to measure dust emissions by steam plants. By checking the performance of new measuring units and determining whether they fulfill the manufacturer's specifications. Measurements by the TUV taken in 1967 on steam boilers with capacities of up to 25 t/h showed that plants without dust collectors emitted on the average 560 mg dust/cu m; those with dust collectors, 170 mg/cu m. For plants with more than 100 Gcal/h, the authorities require the installation of automatic measuring devices for dust and sulfur dioxide. In this connection, TUV checks the available units for suitability and calibrates each individual unit. For dust measurements, photometric units were suitable; for SO2 measurements, infrared absorbers and electroconductivity analyzers were selected. In addition to these activities, TUV is presently engaged with fluorine, hydrocarbon, hydrogen sulfide, sulfur trioxide, carbon monoxide, hydrogen chloride, lead, and zinc oxide measurements. In the years 1965-1966, TUV conducted extensive studies of CO and CH content of automobile exhausts in the idling stage. Infrared absorbers were used for the measurements. Ten percent of the vehicles with four-stroke engines emitted more than 8% CO in the idle; but 45% of the vehicles emitted less than 4.5%. Beginning with October 1, 1970, newly registered automobiles with Otto engines may not emit more than 25 g CO and 1,5 g CH per 100 g fuel consumption. TUV will check the new automobiles for compliance with this law. Finally, odor and noise measurements also belong to the activities of the TUV.

17614

Katz, Morris

CITY PLANNING, INDUSTRIAL-PLANT LOCATION, AND AIR POLLUTION. In: Air Pollution Handbook. P. L. Magil, F. R. Holden, and C. Ackley (eds.), New York, McGraw Hill, 1956, Sect. 2, 53p. 68 refs.

Detroit, Philadelphia, Pittsburgh, Los Angeles, and Houston are cited as examples of cities that have made extensive improvements through city planning. In 1953 there were 75 people in New York City employed by Air Pollution Control, and the budget was about $375,000. The history of pollution control efforts is described for Great Britain, St. Louis, Pittsburgh, Los Angeles, and Detroit-Windsor. The role of meteorological factors is considered, with an enumeration of 6 basic principles of control in the designing of smokestacks. Topographical influence is discussed for Trail, B. C. and Los Angeles. Figures are given on fallout of dust and gas concentrations for various ubran areas. Gases discussed include sulfur dioxide, hydrogen sulfide, hydrogen fluoride, hydrogen chloride, organic sulfides, aldehydes, and smog.

19064

Yocom, John E.

AIR POLLUTION REGULATIONS-THEIR GROWING IMPACT ON ENGINEERING DECISIONS. Chem. Eng., 69(15):103-114, July 23, 1962. 9 refs.

Choice of raw materials, equipment, process variables, plant site, and plant size are all affected by air pollution control requirements. How the regulations work, how they are enforced, and the direction in which they are moving are reported. Local control agencies and state and federal agencies are becoming increasingly interested and active in the area of air pollution control. Various geographical areas are discussed with California getting the major emphasis as the state which has pioneered most of the air pollution control activities. The three broad categories into which control agencies divide emissions into the atmosphere are identified as visible, particulate, and gaseous. One significant and universally accepted policy is that where regulations overlap, all applicable regulations must be complied with. The most widely used type of control regulation for visible emissions is based on the use of the Ringelmann chart. Originally conceived to evaluate shades of grey in smoke plumes from coal fired boilers, its extension to non-grey plumes through the principle of equivalent opacity has created serious problems in interpretation and enforcement. Wet or detached plumes also are the subject of controversy. Regulations covering the control of particulates are generally based on stack concentrations or percent of process weight. The latter concept was conceived by the Los Angeles County Air Pollution Control Department to prevent circumvention of the intent of regulations by diluting stack air. A variation of the stack concentration concept is permitted by the Bay Area Air Pollution Control District which accepts readings based on ground level concentrations. Only a few control agencies have specific limits on SO2 emissions. Most of these are in California and base their regulations on the LACAPCD limit of 0.2 by volume calculated as SO2. Flourides are controlled 'to the extent technically feasible' in San Bernardino and to a limit of 40 ppm in forage grass by the Florida Air Pollution Control Commission. Carbon monoxide remains an automotive problem and will probably not concern the processing industries until the auto makers have finished with it. The trend is to have enforcement remain with local and district agencies with policy and research being handled at the state and federal levels.

19434

Ministry of Labour and Social Welfare. North Rhine-Westphalia, Germany

KEEPING THE AIR PURE IN NORTH RHINE-WESTPHALIA. (Reinhaltung der Luft in Nordrhein Westfalen). Congr. Reinhaltung der Luft, Duesseldorf, West Germany, 1969. (Oct. 13-17.) Translated from German. Bolov and Associates, Denver, Colo., 133p., Feb. 11, 1970.

The centers of industrial concentration in North Rhine-Westphalia are also those of population concentration. The close juxtaposition of these concentrations of emittants of air

pollutant material and the densely situated population causes extreme problems. The directed measures of the last ten years against the unbearable dust load and the harmful sulfur dioxide emissions have led to considerable improvements. Measurements show an extraordinary reduction of dust and SO2 in the air since 1963. While infringements on the dust limit values were found on 22% of the measurement surface at the beginning of the measurement period with 5% of the measuring surface violating the SO2 limit value, in the year 1968 violations were 5% for dust and 1% for SO2. These successes were predominantly due to severe licensing practices for new industrial plants and improvement programs for existing industries that do the most to determine emission concentrations: steel convertors, ore sintering plants, coking furnaces, foundries, and steam power plants. The experiences of the last few years have shown that the problems of air pollution are subject to change and have a continuous connection with the developments in technology and production in industry. An increase of around 25% to 5 million tons SO2 emissions per year is projected from 1967 to 1975. From 1975 on, the production of electric power, which will then account for 40% of the SO2 emissions, will be considerably influenced by atomic energy; SO2 emissions will first stop their increase and then start to decline. Fluorine, hydrocarbons, chlorine, and numerous odor substances will become the focus of attention. The dust problem will no longer be a question of loads due to coarse dust, but dangers to health due to fine dusts. Precipitation measurements will be extended to include concentration measurements. In the coming 10 years, the State will also take an increasingly critical look at emissions from automobiles and domestic heating units. The goal of the State Government is the development of a control system on a regional basis. Data banks will be set up to provide regional data on individual industrial emission sources, as a tool to the development of control programs. This program has already begun in the area of metropolitan Cologne and will soon be extended to the Duisburg/Oberhausen/Mulheim a.d. Ruhr, Essen/Bottrop, Gelsenkirchen/Wanne/Eicket/Bochum, Castrop/Rauxel, and Dortmund regions.

20273

Fletcher, R. H.

KITIMAT POLLUTION CONTROL BY-LAW. Pulp Paper Mag. Can. (Quebec), 71(7):78-90, April 3, 1970. (Presented at the 5th Paper Industry Air and Stream Improvement Conference, Toronto, Ontario, Oct. 21-23, 1969.)

Land use in the 16-yr-old town of Kitimat, B. C., was planned to minimize the conflicts that can exist between residential areas and industry. Prior to the advent of a pulp and paper complex with a 930 tpd Kraft mill and a 150 million fbm per year saw mill, the town's principle industry was an aluminum smelter. To preserve the quality of its environment, the town passed a waste emission by-law that requires the monitoring of selected emissions from the pulp mill and smelter. The law, to become effective in December 1970, identifies a tolerable level of pollution which is expected to be met, but no exceeded, by the two industries. The level of emission from an industry is related both to the type of equipment used and to the way in which it is operated. The levels, determined from experience recorded elsewhere and those found tolerable by local authorities in an assimilation study, are as follows: cinders from power boilers, 150 gr per 1000 cu ft; sodium compounds, 200 gr per 1000 cu ft. all particulate matter; volatile organic sulfur compounds, 0.2 lbs/ton; calcium compounds, 250 gr per 1000 cu ft all particulate matter; and volatile fluorine compounds, 2.5 lbs/ton.

24010

TEST CASE ON INJURY CLAIMS. Chem. Week, vol. 77:34, 36, Dec. 3, 1955.

Reynolds Metals Company has decided to petition the U. S. Court of Appeals in San Francisco to reverse the Sept. 16 verdict in a district court at Portland, Ore., which awarded $38,293 to the Martin family. Up to 1950, the Martins were operating a 1500-acre cattle ranch on a ridge a mile or so east of the Reynolds plant. Their first successful move against Reynolds was a civil suit in which they were awarded $47,000 for damages to cattle and ranch property. In the personal injury suit, Martin contended that fluorine fumes from the plant contaminated not only the air that he and his family breathed but also the vegetables they grew and ate on the ranch. Since 1946 when Reynolds had acquired the plant on the Columbia River, it has installed $2.5 million worth of waste gas treatment equipment. Principal witnesses in the trial are listed, as well as the basis for Reynolds' appeal.

24122

Ludwig, John W.

THE U. S. GOVERNMENT AIR POLLUTION CONTROL PROGRAM. Preprint, Department of Health, Republic of South Africa, 66p., 1970. (Presented at the Conference on Air Pollution, Republic of South Africa, Oct. 14-15, 1970.)

A description of the air pollution control program of the United States Government is presented. The Clean Air Act is the basic document outlining the approach to air pollution control in the U. S. The Air Quality Act of 1967 calls for a systematic, regional effort to combat air pollution. The operating responsibilities for the Federal air pollution program are carried out by the National Air Pollution Control Administration. In its present form, there are 11 organizational units to carry out the operations of the Administration. The Bureau of Criteria and Standards has sub- divisions of Health Effects, Economic Effects, and Air Quality and Emissions Data. The Bureau of Engineering and Physical Sciences has sub-divisions of Process Control Engineering, Chemistry and physics, and Meteorology. The Mobile Source Program involves motor vehicles as sources, and also does research and development work. The Bureau of Abatement and Control is the interface between the Federal program and State and local Agencies. An indication of funding distribution is presented to give a feel for the major program emphasis. The control programs utilize a priority system o pollutants. The order is: sulfur oxides, particulates, nitrogen oxides, carbon monoxide, fluorides, and odors. Many of the control methods now being studied are described. The measurements methods and instrumentation used by NAPCA are described. Programs initiated to forecast air pollution potential and models used in predicting air pollution concentrations are described. The thrust of NAPCA's efforts to control automobile exhausts lies in three areas: induction system alterations, such as fuel injection; alternative fuels, such as natural gas; and exhaust treatment, such as thermal reactors. The functions of the various Offices within NAPCA are described.

24481

Belknap, Herbert J.

AIR POLLUTION CONTROL ON A COMPLEX INDUSTRIAL SITE. Preprint, American Society of Mechanical Engineers, New York, 5p., 1970. 5 refs. (Presented at the American Society of Mechanical Engineers the Plant Engineering and Maintenance Conference, Fort Worth, Tex., March 16-18, 1970, Paper 70-PEM-11.)

The key feature of the centralized air pollution control program at a complex industrial site is the appointment of a staff specialist who is chairman of the plant's Atmospheric Control Committee, composed of chemists and plant, process, and maintenance engineers from each division and building on the site. The specialist has various advisory and coordinating duties for the whole plant, in addition to responsibilities including stack sampling and atmospheric testing. The testing program includes monthly sampling at six locations ringing the plant and colorimetric analysis for sulfur dioxide, nitrogen dioxide, ammonia, and sulfuric, hydrochloric, and hydrofluoric acids; suspended particulates are measured by high volume samples. Metal corrosion tests are also made. The packed bed fume scrubber, extended surface scrubber, and fan-spray scrubber used at the plant are described. Company standards include stack emission limits lower than those permitted by the Texas Air Control Board and concentrations of pollutants in air effluents at (or below) the Threshold Limit Values set by the American Conference of Governmental Industrial Hygienists. Texas Air Control Board regulations are briefly summarized.

25427

Scaiola, Gianni

ESTIMATION OF THE INVESTMENTS AND EXPENDITURES NECESSARY FOR THE ELIMINATION OF POLLUTION. (Stima degli investimenti e dei costi necessari per l'eliminazione dell'inquinamento). Text in Italian. In: L'Intervento Pubblico Contro l'Inquinamento: Rapporto di Sintesi, p. 107-136, June 1970. 9 refs.

The investment, maintenance, and operating costs involved in the elimination of the more important forms of air and water pollution are estimated with reference to automotive emissions (hydrocarbons, carbon monoxide, and nitrogen oxides), industrial emissions (particulate pollution, sulfur dioxide, nitrogen oxides, hydrocarbons, and fluorine compounds), electric power plants, domestic heating (with a table of central heating plants and corresponding population figures for eleven Italian cities), liquid effluents from industrial and private sources, and the marine transport of petroleum and petroleum products. For each category, the procedure is described by which the estimates are made.

25542

Haar, Ulrich de

THE MONITORING STATION PROJECT 'KEEPING THE AIR CLEAN'. (Das Messtellen Projekt 'Reinhaltung der Luft'). Text in German. Umschau (Berlin), 70(23):746-774, Nov. 5, 1970. 3 refs.

The carbon dioxide content in the atmosphere has increased by 16% since the beginning of the century and is expected to double in the first half of the next century. While CO2 does not absorb sunlight, it does absorb night-time long-wave radiation with a resulting increase in atmospheric energy. Increased emission of sulfur dioxide reduced the pH of natural precipitation in the Schwarzwald in Germany from 4.9 in 1965 to 4.5 in 1970 with a resulting decrease of pH in surface waters possessing only a limted buffering capacity and a shift in the hydrobiological equilibrium. It is not enough to measure pollution in highly industrialized areas; pollution spreading to so-called clean air is more dangerous in the long run. For this reason, a network of measuring stations has been established over the Federal German Republic whose objectives are the recording of slow atmospheric changes, the gathering of comparative data for epidemiological studies of population groups from highly polluted areas, and the study of long-term chronic effects of low levels of pollution on humans, plant life, animals, and materials. The data sought include pH, conductivity, dust concentration, soluble and insoluble dust precipitation, chlorine, ammonia, sulfates, CO2, SOx, NO2, F, radioactivity, pollen and spore count, lead level, residual levels of cancerogenic substances and pesticides, N2O, ozone, particle count, SO2 and aerosol spectra, iodine level, heavy metals and terpenes, and the usual meteorological parameters. It is hoped that a similar network will be established all over Europe.

25642

Mein, William Wallace, Jr.

THE CALAVERAS CEMENT CO. DUST SUIT. Mining Engineering, 3(6): 534-536, June 1951. (Presented at the American Institute of Mining, Metallurgical and Petroleum Engineers Meeting, Los Angeles, Calif., Oct. 1949 and New York, Feb. 1950, Paper TP 3047H.

An account is given of the background, testimony, and outcome of a 1949 trial resulting from a suit by five landowners, all cattle ranchers, whose properties are located in the vicinity of a cement plant. The plaintiffs sued for dust damages of $120,338 and for an injunction preventing the company from casting dust on their properties in injurious quantities. Testimony for the plaintiffs was designed to establish that the flue dust had damaged the land and forage and had caused fluorine poisoining to the cattle, both results causing substantial loss of profits. Defense testimony sought to establish that the damage had been enormously exaggerated and should be limited to the much lower loss of rental values, and that the claim of fluorine poisoning was spurious. A jury verdict awarded the ranchers $7508 in damages and the court issued an injunction following the lines of a company proposal requiring a minimum stack dust recovery of 87%. The plaintiffs subsequently filed an appeal, contending that their proposed version of the injunction should be the one adopted by the court; this appeal was still pending at time of writing.

27677

Osaka Prefectural Government (Japan)

OSAKA PREFECTURE PUBLIC NUISANCE CONTROL CODE (PROPOSED). (Osakafu kogi boshi jorelan). Text in Japanese. 29p., Feb. 1971.

The proposed code for Osaka Prefecture consists of general regulations, measures to control public nuisances, such as environmental standards, public nuisance control plans, and regulations for factories, including regulating smoke and dust, and reporting nuisance-creating facilities. Public nuisances from factories consist of smoke and dust, polluted water, bad odors, noise, and vibrations. There are special provisions concerning extraction of ground water, special construction activities, automobile traffic, use of loud speakers, and monitoring of air pollution. Air pollutants under consideration are sulfur oxides, dusts, cadmium, chlorine, hydrogen fluoride, lead and other substances potentially harmful to human health.

28014

LEGAL NOTE ... LIABILITY FOR AIR POLLUTION. Public Health Rept. (U. S.), 74(2):104, Feb. 1959. 1 ref.

In a suit for damages resulting from fluoride poisoning allegedly caused by the defendant's aluminum reduction plant, the plaintiff was unable to specify any particular acts of negligence by the defendant and was compelled to rely on the legal doctrine of 'res ipsa loquitur' (the thing speaks for itself). This doctrine, according to which the facts of the occurrence

warrant the inference of negligence, was held applicable by a court of appeals. The defendant's evidence of reasonable care was considered insufficient to require finding as a matter of law that inference of negligence had been overcome.

28349

Industrial Engineering Center (Japan)

DATA FOR THE SEMINAR ON INDUSTRIAL POLLUTIONS PREVENTION COUNTERMEASURES, NO. 1: PROBLEMS AND FUTURE TRENDS IN LEGISLATION RELATED TO INDUSTRIAL POLLUTION PREVENTION. (Sangyo kogai boshi taisaku semina shiryo, No. 1, sangyo kogai boshi kanren horei no mondaiten to kongo no doko). Text in Japanese. 12p., 1970 (?).

At the 64th Extraordinary Diet session, held from November to December, 1970, 14 laws including the partial amendment of Pollution Countermeasures Fundamental Law, the Air Pollution Prevention Law, and the Water Pollution Prevention Law were passed. With the exception of the law partially amending the Agricultural Chemicals Control Law, all laws were promulgated as of December 25, 1970. Although the Fundamental Law came into force immediately, most of the other laws will become effective six months later due to the time required to prepare ordinances, ministerial regulations, and public notices. A comparison between the old, the new legislation concerning water pollution is given in tabular form, and the scope of each news law is explained. In sections on 'objectives' of the Fundamental Law, Air Pollution Prevention Law, the Water Pollution Prevention Law, and the Noise Control Law, the phrase 'in harmony between living environment and sound level development of economy' is deleted. The system designating special areas for the control of air and water pollution is lifted; control is to be extended to all the areas and public waters in Japan. National minimum discharge standards are established. In the Fundamental Law, soil pollution was stipulated as the seventh typical pollution and a law on 'the prevention of soil pollution for agricultural use' was established. A drastic amendment of the old Cleaning Law was made and the new law on 'treatment and cleaning of wastes' was established. Besides sulfur oxides, soot and dust, chlorine, hydrofluoride, cadmium and lead are controlled under the Air Pollution Prevention Law, while heated and colored water discharge are controlled by the Water Pollution Prevention Law. The range of industry is extended from primary to tertiary. Responsibility of entrepreneurs is clarified in the Fundamental Law to mean that they are to take 'necessary measures to prevent pollution such as treatment of sooty smoke, filthy water, and wastes'. The law on the sharing of pollution-control expenses was established. in keeping with Article 22 of the Fundamental Law, which stipulates the responsibility of entrepreneurs to bear the burden of expenses. Some responsibilities and authority are entrusted by the national government to local autonomous bodies. The future problems are: steps to make adequate use of land, further improvement in enterprises to prevent pollution, establishment of Environmental Agency, financial assistance to local area, enterprises, legislation on odor, and promotion of technology.

29421

OUTLINE OF LEGISLATIONS CONCERNING POLLUTIONS PASSED BY THE EXTRAORDINARY DIET SESSION. (Rinji kokkai seiritsu kogai kankei horitsu yoko). Text in Japanese. 16p., Dec. 21, 1970.

Legislation is outlined including, the Water Pollution Prevention Law, the law which partially amends the Pollution Countermeasure Fundamental Law, the law which partially amends the Air Pollution Law, the Water Pollution Prevention Law, the law which partially amends the Noise Control Law, the Marine Pollution Prevention Law, the law on the sharing of the financial burden for pollution prevention, the law on the punishment of crimes involving pollution harmful to human health, the law concerning waste treatment and cleaning, the law concerning the prevention of soil pollution, the law which partially amends the Sewer law, the law which partially amends the Road Traffic Law, the law which partially amends the Agricultural Chemicals Control Law, and the law which partially amends the Poison and Poisonous Matters Control Law. The definition of pollution is changed to include soil pollution, heated water from thermal generating stations, and paper mill sludge. The phrase, harmony with sound development of economy was delected, and it is now the responsibility of entrepreneurs to dispose of industrial wastes. The system of designating special areas for air and water pollution was abolished, and the emission standard is applicable all over Japan. Besides sulfur dioxide in factory smoke, cadmium, hydrogen fluoride, and lead are specifically mentioned. Governors can limit the use of facilities which emit sooty smoke and advise them to comply with standards on the use of fuel, improve water pollution, and prevent soil pollution. Also, the discharge of oil from vessels is restricted. A person in charge of controlling oil pollution must be designated to each vessel. Of willfull damages to health and life, are punishable by prison terms of detention of less than 2 years or of fines less than 716 dollars. Heavier penalties occur in the case of death or injuries. Individuals and corporations are punishable. Companies must manufacture easily disposable goods. Areas are designated which are feared to be heavily contaminated. Sewers must have a terminal disposal plant, or be connected with the sewer system. The Public Safety Commission can install and control traffic signals, and prohibit traffic, if necessary.

29504

Ministry of International Trade and Industry (Japan), Secretariat

COLLECTION OF LEGISLATIONS RELATED WITH MITI CONCERNING POLLUTIONS. (Tsusho sangyo kankei horeishu). Text in Japanese. Tokyo, Japan, Tokyo Hoki Publishing Co., May 1971, 270p.

As of April 1, 1971, the ordinance on the enforcement of the Air Pollution Control Law and the law on the consolidation of the Kinki region (regarding the designation of special areas for the maintenance of the environment) were revised. The ordinance referred to in paragraph 5, Article 2 of the Law designates these substances: ammonia, hydrofluoric acid, hydrogen cyanide, carbon monoxide, formaldehyde, methanol, hydrogen sulfide, phosphoric acid, hydrochloric acid, nitrogen dioxide, acrolein, sulfur dioxide, chlorine, carbon disulfide, benzene, pyridine, phenol, sulfuric acid (including sulfur trioxide), silicon fluoride, phosgene, selenium, dioxide, chlorosulfonic acid, yellow phosphorous, phosphorous trichloride, bromine, nickel carbonyl, phosphorous pentachloride, and mercaptan. The allowable limit for SO2 in the atmosphere is 2/10 mil, an annual hourly maximum, or 0.6/10 ml annual hourly average. When hours exceeding 2/10 mil do not exceed 75 hours a year, only the annual hourly average can be taken. The measurement of the hourly figure is determined by the ordinances of the Ministry of Health and Welfare and the Ministry of International Trade and Welfare. The measurement of sooty smoke and particulates are also in accordance with the law. In the Construction Standards Law Enforcement Regulations, revised December 2, 1970, as Ordinance No. 333, Arti-

cle 126 stipulates smoke elimination facilities and chimney stacks for buildings. Law No. 144 limits factories in already established urban areas in the Kinki Region.

29598

Toyama Prefecture (Japan), Dept. of Environmental Pollution

PRESENT SITUATION OF ADMINISTRATION CONCERNING POLLUTIONS. (Kogai gyosei no genkyo). Text in Japanese. 74p., Oct. 1970.

Aluminum smelters and thermal generation stations in the hinterland of Toyama prefecture, have signed an agreement with Toyama Prefecture concerning the prevention of air pollution, but the problem of air pollution is becoming complicated and diversified. Although no concentration is as high as the environmental standard, control was strengthened by amending K 29.2 to 20.4 and adding five observation stations, and a central telemeter monitoring system. Dust collector facilities for electric furnaces lowered the concentration of exhaust smoke from electric furnaces to within the range of standard. With the increase of ferro-alloy, iron, and steel production, on-site checks will be made and guidance will be given on high efficiency dust collecting equipment. With the revision in the sulfur dioxide standard, 56 production facilities, 17% of the factories under control, no longer qualified. At the moment, the chimney height is being raised, a switch to LS heavy oi is being made, and as of the end of March, 1970, about 40% had completed the improvement. Carbon monoxide checks were made in 196 at major locations on traffic congestion in two cities, and they will be continued this year. Since the start of aluminum productio by Sumitomo Chemical Industry, an agreement was signed with the company concerning fluorine. Indicator plants were placed, and on-site checks have been made. Of the 13 staffs on environmental pollution at the prefectural government, four are in charge of air pollution. Of 192 complaints concerning pollution received in 1969 42 were on air pollution. Between September 19, 1969 and October 30, 1969, $583.60 was spent on a survey of air pollution by the prefectural government. As of end of March, 1970, 430 facilities which emit smoke reported in accordance with Air Pollution Prevention Law. Between 1967 and 1969, nine smaller enterprises were given financial aid to improve facilities to prevent air pollution.

29818

Tokyo Metropolitan Government (Japan), Bureau of Sanitation

MATERIALS FOR REFERENCE ABOUT ENVIRONMENTAL POLLUTION CONTROL. Kogai hoken sanko shiryo). Text in Japanese. 39p., March 1971.

The present state of and the future problems of the administration of environmental pollution control in Tokyo, the injuries to health by these pollutants, and their prevention are discussed. Materials for reference are as follows: the definition of environmental pollution in the basic law of environmental pollution (Kogai); Japanese Air pollution regulations; the history of air pollution in Japan; kinds, physical and chemical characteristics amounts, actions and sources of air pollutants; standards for warnings, and alarms pollutions; influence on the human body; and items in the Tokyo medical examination of community inhabitants for environmental pollution (physical examination of the respiratory organ system). The division of duties in the Pollution Disease Section and the organization of the Bureau of Environmental Protection are also mentioned. Major pollutants discussed include nitric oxide, chlorine, fluorine, carbon dioxide, methane, nitrogen dioxide, ozone, sulfur dioxide, ammonia, sodium chloride, carbon monoxide, iodine, dusts, fumes, mists, hydrogen sulfide, and sulfuric, nitric, hydrofluoric, and hydrochloric acid.

30620

Kawamoto, Hirotaka

EXPLANATION OF AIR POLLUTION CONTROL ACT. (Taiki osen boshiho no kaisetsu). Text in Japanese. Ryusan (J. Sulphuric Acid Assoc., Japan), 24(3):21-31, March 1971.

The Air Pollution Control law passed by the 64th Extraordinary Diet session, aims at control of smoke, dust, exhaust gas, and special matter. Smoke is divided into sooty dust, sulfur oxides, harmful matter, and special harmful matter. Facilities which generate smoke are defined. Sooty dust generated by the incineration of fuel or by the use of electricity is the same as the traditional soot and other dusts; it includes soot, ash, metal, and other oxides generated by combustion. Use of electricity as a heat source implies the electric furnace process, for instance Harmful matter is defined as that generated by combustion, synthesis, decomposition, or other waste disposal methods (except mechanical process). Examples are cadmium, chlorine, fluoride, and lead. Special harmful matter is that generated, for example by combustion of nitrogen oxides. Facilities which generate harmful substances include electrolytic furnaces, reactors, crucibles and converters. Those who want to establish smoke-generating facilities must provide regional authorities with necessary information. Those who do not conform to the smoke standard are punished, ordered to alter their plan, or to abandon it. Mines are excluded from the definition of the facilities which generate smoke, as they come under the more strict Mine Safety Law. The smoke discharge standard is universal throughout Japan. The following smoke environmental standards apply: hourly values must be less than 0.2 ppm for 99% of the total hrs/yr; daily averages must be less than 0.05 ppm for over 70% of the total days/yr; hourly values must be less than 0.1 ppm for over 88% of the total hs/yr; the average annual hourly value cannot exceed 0.05 ppm. In any area, the number of days calling for emergency measures is not to exceed three percent of the total days/hr or to continue beyond three days. The standards are to be realized within 10 year in congested areas and within five years in already polluted areas.

31492

Boer, Wolfgang

BASIC PROBLEMS OF AIR POLLUTION IN THE GERMAN DEMOCRATIC REPUBLIC AND POSSIBILITIES FOR THEIR SOI UTION. (Grundprobleme der Reinhaltung der Luft in der Deutschen Demokratischen Republik und Moeglichkeiten ihrer Loesung). Text in German. Energie Tech., 21(6):274-277, June 1971.

In the German Democratic Republic, it is expected that the sulfur dioxide pollution, caused by the combustion of fossil fuels, will continue to rise until 1975 and the following years. In industrial centers, SO2 will thus continue to be the major pollutant. The exhaust gases from automobiles pose problems. Tests of two- stroke engines revealed that they do not emit more pollutants than four-stroke engines. A solution of the exhaust gas emission is seen only in the construction of an entirely new type of engine. As long as there are combustion engines there will be emissions. Numerous injuries to crops and forests were found to stem from fluorine emissions, rather than from SO2 emissions. The present air pollution situation was used as basis for the air Pollution Regulations, which call for maximum allowable emission concentrations, which are set by the Health Ministry and which will be established by the individual organs in the economic sector. The emissions will be

controlled by the district hygiene inspectors and the companies themselves. Any negligence in meeting the standards will be punished by the collection of a certain fee.

32173

Orange County Air Pollution Control District, Anaheim, Calif.

RULES AND REGULATIONS. 34p., Dec. 23, 1969.

Rules and regulations governing air pollution emissions and control are reviewed for Orange County. General terms and standard conditions are defined. Permits, fees, and fee schedules are examined. Emission standards are presented for particulate matter, visible contaminants, sulfur compounds (sulfur dioxide), combustion contaminants (carbon dioxide), fluorine compounds, scavenger plants, dust, fumes, storage of petroleum products, open fires, incineration, gasoline loading, oil-effluent water separator, sulfur content of fuels, gasoline specifications, organic solvents, fuel burning equipment, architectural coatings, and orchard or citrus grove heaters. Legal procedures before the Hearing Board are delineated.

32245

San Bernardino County Air Pollution Control District, Calif.

RULES AND REGULATIONS. 62p., Aug. 18, 1970. (Includes Amendments to San Bernardino County Air Pollution Control District Rules and Regulations).

Rules and regulations concerning air pollution emissions and control in San Bernardino County are reviewed. General pollution terms are defined. Permits and fees for schedules of electric motor horsepower equipment, fuel burning equipment, electrical energy use, incinerators, stationary containers, and orchard heaters are discussed. Pollution emission standards are examined for particulate matter, specific contaminants (sulfur dioxide, carbon dioxide, and fluorine compounds), scavenger plants, dust, fumes, storage of petroleum products, open fires, incineration, oil effluent water separators, gasoline loading, sulfur content of fuels, gasoline specifications, organic solvents, architectural coatings, and fuel burning equipment. Procedures of the board are reviewed. Emergency regulations are determined for air sampling and sampling stations, alerts, communication systems, and toxic air pollutant levels of carbon monoxide, nitrogen oxides, sulfur oxides, and ozone.

32272

San Diego County Air Pollution Control District, Calif.

RULES AND REGULATIONS. 34p., Aug. 1970.

Rules and regulations governing air pollution emissions and control in San Diego County are reviewed. General terms and standard conditions are defined. Permits and fees are explained. Standards on emissions are examined with respect to the Ringelmann chart, particulate matter, specific contaminants (sulfur dioxide, carbon dioxide, and fluorine compounds), scavenger plants, dust, fumes, open fires, incineration, and sulfur content of fuels. Rules concerning orchard or citrus grove heaters and legal board procedures are determined.

32354

Nordrhein-Westfalen Arbeits-und Sozialminister (West Germany)

PLANS AND GOALS OF THE STATE GOVERNMENT TILL 1975. (Plaene und Ziele der Landesregierung bis 1975). Text in German. In: Reinhaltung der Luft in Nordrhein Westfalen. Essen, West Germany, Brinck and Co. KG, 1969, p. 84-93.

The state government has adopted a new regional approach to all pollution control planning. Abatement programs instituted for Thomas steel converters, ore sintering plants, cokeries, foundries, and steam power plants will terminate in 1973. In selected industrial centers with high pollution emissions, all industrial, domestic, and automotive polluters will be rechecked and results of the survey will be used as a basis for pollution control improvement and for planning and legislative purposes. An emission register (map) of Cologne, Duisburg-Oberhausen-Muelheim an der Ruhr, Essen-Bottrop, Gelsenkirchen-Wanne/Eickel-Bochum, Gastrop-Rauxel, and Dortmund will be compiled and used for purposes of pollution forecasting. Measurement data show that chemical and petrochemical plants contribute an inordinately large share to overall pollution; these plants will have to install new equipment to reduce emissions of concentrated reaction gases, odorous gases, and gases with high particulate content. New monitoring programs will be instituted for fluorine, hydrocarbons, odorous sulfur and nitrogen compounds, hydrogen chloride, and oxidants and particulates in an area extending from Cologne to Dortmund. New regulations will be issued governing maximum permissible emissions from all domestic heating plants fired by oil, coke, or coal. The incineration of solid waste in heating plants will be prohibited.

32789

Public Nuisance Control Assoc., Tokyo (Japan)

LAWS AND ORDINANCES RELEVANT TO AIR POLLUTION. (Taiki osen boshiho seko rei). Text in Japanese. Sangyo Kogai (Ind. Public Nuisance), 7(7):322-331, July 1971.

On the basis of the Air Pollution Prevention Act, regulations have been issued designating pollutants, the maximum permissible emission, emission sources, and pollution areas. Among the materials produced by combustion, synthesis, and decomposition, elements that have been designated as toxic are cadmium and its compounds, chloride and its compounds, fluoride, hydrogen fluoride, and silicon fluoride, lead and its compounds, and nitrogen oxides. Toxic materials emitted by automobiles are carbon monoxide, hydrocarbons, lead compounds, and nitrogen oxides. Toxic material that should be guarded against at the time of accidents at manufacturing plants consist of 28 items including NH3 and HF. The maximum permissible amount of toxic matter concentration per hour at the highest point during the year should be less than 0.1 ppm. Twenty-six kinds of soot producing apparatus and systems are subject to regulations, and five kinds of particulate producing furnaces and apparatus are subject to regulations. Also included are areas subject to sulfur oxides concentration control and areas subject to advice for the use of low-sulfur content fuels.

32884

Smaller Enterprises Promotion Corp. (Japan)

AMENDMENT DRAFT AND EXPLANATION OF AIR POLLUTION CONTROL LAW ENFORCEMENT REGULATIONS. (Taiki osen boshiho sekorei no kaiselan oyobi kaisetsu). Text in Japanese. Preprint, 20p., 1971. (Presented at the Public Nuisance Prevent. Tech. Seminar, Japan, 1971.)

Air pollution control laws and amendments in Japan are examined. Regions are divided into eight classes based on the discharge standard of sulfur dioxide, for which the maximum allowable concentration is 0.020-0.045 ppm at groung level. Industries discharging smoke, cadmium, or lead and boilers burning heavy oils must be equipped with electric dust collectors, bag filters, or multi-cyclones. In certain areas, buildings with central heating must install multi-cyclones or more effi-

cient dust collectors or change to gas or electric heating. The prefectural governments may adopt emission standards stricter than those enforced by the national government. Industries discharging chlorine or fluorine must be equipped with alkali washing devices. Sulfur content in fuels is limited to 1.0-1.5%.

33495

Morgan, George B. and Guntis Ozolins

AIR QUALITY SURVEILLANCE. Preprint, Air Pollution Control Office, Cincinnati, Ohio, Div. of Atmospheric Surveillance, 23p., May 21, 1971.

The specific needs for air quality data, the scope and requirements of monitoring activities, and the chief components of ambient air quality surveillance such as sampling-measurement networks, laboratory support, and data handling and analysis were presented. The monitoring conducted by state and local air pollution control agencies is directed toward enforcement activities. The Federal monitoring system provides a uniform data base throughout the country against which all other air quality data can be verified. States must provide adequate monitoring of total suspended particulates, sulfur dioxide, carbon monoxide, nitrogen oxides, oxidants, and total hydrocarbons. The number of sampling stations required depends primarily on existing pollution levels, their geographical and temporal variability, and the size of the region. The number of sampling stations must be adequate to allow definition of the area or areas where ambient concentrations may be expected to exceed those designated in air quality standards. Station locations and sampling site characteristics were discussed. The sampling frequencies for mechanical samplers and the averaging times for automatic samplers are dictated by ambient air quality standards. The frequencies (continuous, daily, or weekly) are given for suspended particulates, lead, polycyclic organic matter, fluorides, SO2, CO, HC, nitrogen dioxide, NOx, and ozone for urban and rural areas. With automatic instrumentation the need for routine laboratory support is greatly reduced but a problem of data transmission, validation, and reduction is introduced. Trends in urban air quality were also reviewed.

33722

Tokyo Metropolitan Equipment and Supplies Bureau (Japan), Air Pollution Regulation Project

STANDARD REGULATION FOR THE TREATMENT OF POISONOUS GASES (1). (Yugai gasu shorishisetsu shido hyojun (1)). Text in Japanese. 186p., March 1970.

A standard regulation was established for treating generated poisonous gases in Tokyo. A packed tower or the combination of packed and spray towers should be used for the treatment of ammonia gas. Gas-liquid contact equipment may be used to wash gas provided it is equal to or higher than the towers in control efficiency. Maximum ammonia concentration in waste gas was determined at 500 ppm; average concentration during manufacturing was 250 ppm. For reference purposes, gas cleaning apparatus, absorption of waste gas, analysis of waste gas and drained water, standards for regulation of waste gas from a factory, and the standard of the treatment of drained water from a factory were described. Fluorine and fluoric compounds should be treated by washing with a jet scrubber or spray tower. Maximum fluorine concentration was set at 15 ppm and average concentration during manufacturing was 10 ppm. General properties of fluoric compounds, sources of fluoric compounds emissions and examples of equipment for treating gases containing fluorine are examined. Hydrogen sulfide should be treated with the aspiration system of a tower using alkali. Maximum H2S concentration in waste gas, was set at 50 ppm, 30 ppm was the standard average during manufacturing.

35795

Shinmura, Gakushi

PARTIAL REVISION OF ORDINANCES RELATED TO AIR POLLUTION CONTROL LAWS. (Taiki osen boshi ho kankei horei no ichibu kaisei nado ni tsuite). Text in Japanese. Nihon Gasu Kyokai-shi (J. Japan Gas Assoc.), 24(9):26-29, Nov. 1971.

Commentaries are made on the main points of revisions in the Air Pollution Control Act passed by the 64th Diet session in the fall of 1970 and ministrial ordinances issued on June 26, 1971 on related matters. The main revisions in the Air Pollution Control Act include: the abolishment of specific control area systems and the application of emission and maximum concentration standards to the entire nation; prerogatives of local governments in issuing more strict emission standards than the national standards when deemed necessary; regulations controlling the use of fuels for especially polluted urban areas; and designation of emission standards for toxic materials and dust particles. Revisions made on the enforcement ordinances give specified toxic materials as cadmium, chlorine, hydrogen chloride, fluorine, hydrogen fluoride, silicon fluoride, lead, and nitrogen oxides. Comments and explanations are given on various dust and soot creating facilities and emission standards, areas with special sulfur oxide emission standards, fuel use control areas, emergency countermeasures, administrative responsibilities, and various technical standards and applications in gas work operations.

37747

Kobayashi, Gen

THE CHARACTERISTICS OF POLLUTION CONTROL LAWS OF IBARAGI PREFECTURE AND THE ROLE OF THE POLLUTION CONTROL AGREEMENT. (Ibaragiken ni okeru kogai boshi jorei no tokucho to kogai boshi jorei no tokucho to kogai boshi kyotei no yakuwari). Text in Japanese. Kagaku Koho (Chem. Factory), 15(13):94-98, Dec. 1971.

The background, content, characteristics, and the role of the pollution control laws of Ibaragi prefecture are discussed, particularly with regard to the liquid waste discharge standard. As to air pollution, special permission must be obtained for the construction or operation of new factories engaged in metal refining, electroplating, dye adjusting, paper or pulp mills, or manufacturing of cement, asphalt, alcohol, fertilizer, or starch; for those factories which use mercury, cadmium, lead, fluorine, cyanogen, organic phosphorus compounds, arsenic, or chromium; and for those factories which emit a maximum of more than 5000 cu m or consume the maximum of more than 50 kl heavy oil. The maximum permissible hydrogen chloride emission in the air is 70 mg, and for fluorine, hydrogen fluoride, and silicon fluoride it is 4 mg, in the Kashima area. Permission to operate certain kinds of plants depends on strict adherence to the standards, and violation will lead to cancellation of permission. Unauthorized companies and those which have lost permission must stop operating immediately; violation of the ordinance will lead to the most severe penalty. Such regulations are applicable to dust creating installations such as ash manufacturers, power cotton gins, agricultural chemical plant, pottery factories, soil and stone packers, and bad odor producing installations such as livestock yards, chicken feces, drying plants, and pulp mills.

37943

Toyama Prefecture (Japan)

TOYAMA PREFECTURAL WHITE PAPER ON ENVIRONMENTAL POLLUTIONS REPORT FOR 1970, ADMINISTRATIVE ACTIONS FOR 1971. (Toyama-ken kogai hakusho, showa 45 nendo nenji hokoku, showa 46 nendo no shisaku). Text in Japanese. 186p., Aug. 1971.

The situation of environmental pollution consists of air, water, noise pollutions, and odor pollution. Complaints due to environmental pollution are mentioned. Air pollution tends to be high in the Toyama-Takaoka area and Uozu or Kurobe. Falling soot and dust occurs locally in Toyama, Takaoka, and Shin Minato cities where smelting and iron factories are located, but it tends to decrease annually. In the first two cities, sulfur oxides concentrations which exceed the environmental standard is observed. The floating dust is generally low. Pollution due to fluoride compounds or carbon monoxide is considered to be important as a future problem. The poultry industry and hog raising are sources of bad odors, and the marine products industry is also a problem. Actions for the prevention of environmental pollution, countermeasures taken for each kind of pollution, and fundamental measures are explained. Items on the environmental atmosphere, a plant survey, environmental health measures, polluted soil, and countermeasures for farming crops, are explained. Fundamental preventive measures that are scheduled to be taken for 1970 and concrete actions for each kind of pollution are also discussed. The Itai-Itai disease and the Toyama Prefectural Ordinance for preventing environmental pollutions are mentioned.

38573

Collin, Fredrik C.

CHOICE OF SITE FOR AIR POLLUTION CAUSING INDUSTRIAL PLANTS AND COSTS OF GAS CLEANING. (Litt om placering industri med luftforurensningsproblemer og om utgiftene med gassrensning). Text in Norwegian. Tek. Ukeblad (Oslo), 119(5):15-17, 19, Feb. 1972.

Air pollution-related conflicts between industrial plants and their surroundings can be minimized or eliminated by preliminary studies and proper choice of sites. The requirement for the possibility of eliminating wastes without direct damages to the environment should be considered in addition to the economic aspects of the choice of the site. In the metallurgic industry, ferroalloy and aluminum plants pollute the air in a radius of about 10 km. A minimum distance of 5-10 km should be kept between new plants and residential areas, taking future expansions into account. Any home building should be prohibited near existing or planned industrial plants. Costs involved in air pollution control in the aluminum industry are discussed. The actual costs are reduced by the fluorine recovery at the Lista Aluminiumverk. Electrostatic filters proved to be unsatisfactory for the cleaning of gases from open-hearth furnaces in a ferrosilicon manufacturing plant. The glass-fiber bag filters applied now cause 10% increase in the price of the products. Changes are needed in the raw material treatment to reduce both smoke emissions and power requirements. To produce marketable products, international cooperation in air pollution problems is needed. Contributions by the state towards investments are a necessity.

38669

Osaka Prefectural Government (Japan), Div. of Atmosphere

AIR POLLUTION CONTROL LAW INSTRUCTIONAL DATA. (Taiki osen boshiho setsumei shiryo). Text in Japanese. 14p., 1971.

Instructions and explanations are given concerning the air pollution control law and the main points of revisions. The organization and system of the law are explained by a flowchart. Regulations are applicable to stack gases including sulfur oxides, soot, general and special toxic gases, special toxic materials, and dust particles. With regard to emission standards, sulfur oxide emission standards are categorized in eight groups and are determined locally. Stack gas, soot, and toxic gas emission standards are determined nationally, and special emission standards are applicable to soot and special toxic gases. Violations in all categories of stack gases are subject to penalties. Standards for special toxic materials are determined case by case at the time of accident. Dust emission standards are determined depending on the structure, use, and maintenance of facilities. These last two items are not subject to penalty. The method of enforcement of improvement orders and the period of improvements are reviewed by a table. Items and facilities that require registration and reporting are reviewed by a table. Facilities designated as soot and stack gas emission sources are reviewed by a table. Emission standards with regard to categories and usage, the old and new standards, and control areas are reviewed by tables and maps. Emission standards of special toxic materials such as cadmium and compounds, chlorine, hydrogen chloride, fluorine, hydrogen and silicon fluorides, and lead and compounds, are reviewed by a table. Dust creating facilities and their management standards are given.

39306

Mahler, E. A. J.

THE FIGHT AGAINST AIR POLLUTION IN THE VICINITY OF INDUSTRIAL WORKS IN GREAT BRITAIN. (Die Bekaempfung der Luftverunreinigung in der Umgebung industrieller Betriebe in Grossbritannien). Text in German. Eidgenoessische Kommission fuer Lufthygiene, Zurich (Switzerland), Probleme der Luftverunreinigung durch die Industrie, p. 15-22, 1968. (Sept. 9-10) (Presented at the Schweizerisches Treffen fuer Chemie, 2nd, Basel, Switzerland.)

British regulations for combatting emissions from emissions from industrial plants include the Public Health Act of 1936, the Clean Air Act of 1956, the Alkali Works Regulation Act of 1906, and the Alkali Works Order of 1966. The Clean Air Act contains regulations about minimum height of chimneys and limitations in soot emissions. The Alkali Acts specify recommended means for determining standards of maximum permissible concentrations of air pollutants. The manufacture of Fletton bricks from clay containing 10% carbon and 500 to 700 ppm fluorine which generates emissions of sulfur dioxide, fluorine compounds, and an offensive smell. Various methods for removal of SO2 and F, such as the Monsanto method, have been tried but have proved impractical in view of the very large volume of waste gases to be handled. For the time being, dispersion of waste gases by means of high chimneys has been the only effective practical remedy. In thermal power stations, removal of sulfur dioxide by forcing the waste gases through ammonia scrubber installations has been very satisfactory, provided that inexpensive ammonia is available and a market for ammonium sulfate assured. Other power plants use water with additions of chalk or calcium carbonate as scrubbing liquids. The drawback of this method is the cooling of the waste gases which then lose their buoyancy and descend to the ground, causing formation of haze and offensive smells. Dispersion of waste gases by 600 to 800 foot chimneys is so far considered the most practical remedy.

39749

Damon, W. A.

THE ALKALI ACT AND THE WORK OF THE ALKALI INSPECTORS Roy. Soc. Health J. (London), 76(9):566-575, 1956. 16 refs. (Presented at the Conference of Sanitary Inspectors, Health Congress, Blackpool, England, April 26, 1956.)

About the middle of the last century, great indignation was caused by the discharge of hydrogen chloride from the new process for manufacture of alkali or sodium carbonate. So great was the outcry and so frequent were the actions for damages that a Royal Commission was appointed, and following its report the first alkali Act of 1863 was passed. It stipulated that not less than 95% of the HCl produced in the process of making alkali should be condensed or absorbed. The residual 5% might be discharged into the air provided it was diluted to contain not more than 1/5 grain of HCl per cu ft. The Act also provided for the setting up of a central staff of inspectors under the control of the Local Government Board. The original Act was extended by subsequent legislation at intervals until 1906 when the current Alkali Act- Works Regulation Act was passed. General provisions, statutory limits, and the Alkali Inspectorate are described. Chemical and physical methods for treating waste gases and chimney dispersal are mentioned. The owners of process schedules under the Alkali Act are required to adopt the best practicable means whereby this discharge of noxious or offensive gases may be reduced and the residue discharged harmlessly and inoffensively. Sulfuric acid processes, viscose processes, cement manufacture, and petroleum refining are mentioned. Non-scheduled processes include electricity generating stations, coal carbonization works, ironworks, steelworks, ceramic works, and fluorine emissions. The clean Air Bill is cited.

40461

ENVIRONMENT PROTECTION. (Umweltschutz). Text in German. Tech. Ueberwach. (Duesseldorf), 13(5):181-187, May 1972.

The German Federal Government is actually reading the bill concerning the protection against harmful environment influences due to air pollution. The bill states that plants emitting air polluting gases or substances require a special authorization. The supervision of emissions will be intensified. Analyses have been made in various enterprises like melting plants, incineration plants, and cement works concerning the emission of dust, sulfur dioxide, sulfuric acid, gaseous fluoride and chloride compounds, hydrogen chloride, hydrogen sulfide, and carbon monoxide. With regard to the emission of CO, nitric oxide, and hydrocarbons by automobile engines, a test station has been established at Essen which undertakes all exhaust gas examinations. However, these examinations concern only relatively new vehicles so that a sensible reduction of the CO contents in the exhaust gases will be reached only if the new exhaust gas prescriptions are generally valid for all vehicles.

40889

Crone, J., R. Schumacher, and E. Luescher

DEMANDS ON A MEASURING SYSTEM FOR MONITORING AIR POLLUTION DEMONSTRATED BY THE EXAMPLE OF THE CITY OF MUNICH. (Anforderungen an ein Messystem zur Ueberwachung der Luftverunreinigung am Beispiel der Stadt Menchen). Text in German. Gesundh. Ingr., 93(3):71-76, March 1972. 6 refs.

The plans for the development of an air pollution monitoring grid for Munich are reviewed. The measurement grid must be capable of determining the momentary air pollution situation over the entire city and its suburbs; simultaneously provide an air pollution alert service; determine the type of air pollutant and locate its source; and draw conclusions from short-term data on the long-term changes of atmospheric pollution. The parameters to be measured will include sulfur dioxide, carbon monoxide, carbon dioxide, nitric oxide, nitrogen dioxide, hydrocarbons, ozone, hydrogen sulfide, hydrogen fluoride, hydrogen chloride, aerosols, tempertature relative humidity, and wind direction and velocity. For the first phase, 30 stations will suffice. The main stations will monitor all parameters with the exception of halogens and hydrogen sulfide. Secondary stations which measure the SO2, CO , NO, and NO2 concentrations; 2 stations will monitor single emission sources such as incinerators with additional measurement of halogens and H2S. One mobile station will be used at an arbitrary place for all measurements and even for long-term measurements. All data will be transmitted to a data computer center. The minimum sensitivity of the units will have to correspond to the background concentration in the atmosphere of non-polluted areas. Proposals by various companies will be evaluated according to certain criteria giving priority to scientific and technological perfection rather than costs.

41455

Swieboda, M.

AIR CONSERVATION IN THE CRACOW VOIVODSHIP. Air Conserv. (English translation from Polish of: Ochrona Powietrza), 3(1):1-9, 1969, 19 refs. NTIS: TT 70-55123/1

The Cracow province is second only to Silesia in the magnitude of the threat posed by air pollution and is classified as an area where the threat of air pollution is of medium intensity. A number of industrial concentrations, however, present serious problems. The dense network of industrial plants in the Cracow industrial region has allowed an overlapping of emissions resulting in an extremely complex condition. The principle noxious substances emitted are sulfur compounds, i.e., sulfur dioxide, sulfuric acid, hydrogen sulfude, and carbon bisulfide, carbon monoxides, nitrogen oxides, fluorine compounds, chlorine, hydrocarbons, and lead and zinc dusts. Lead dust concentrations around the Boreslaw Mining and Foundry Plants were estimated at one ton/sq km/yr; zinc was estimated at 0.3-0.5 ton/sq km/yr. An increase in the degree of air pollution was noticed in Cracow city itself. Dust precipitation varies betwen 200 and 600 ton/sq km/yr. A sharp increase in ambient dust concentration is noted in the fall and winter the admissible standard is 0.21 mg/cu m. The industrial regions of the Cracow area have suffered great vegetation damage. In the Olkucz forest and in the Chrzanow district, over 21,000 hectares of wooded land were destroyed. Industry alone holds the key to preventing or controlling air pollution and forest injuries in industrial districts. Existing abatement regulations place the responsibility on offending factories with respect to building, installing, and operating dust removal equipment. Numerous attempts were made between 1918 and 1938 to control air pollution in the city of Cracow. The principle legal document upon which control operations and cooperation can develop is the Resolution of the Cracow City Government and the Act on Air Pollution Control.

42021

Japan Environmental Agency

WHITE PAPER ON ENVIRONMENT - A NEW GOAL FOR ENVIRONMENTAL POLICY. (Showa 47 nenban kankyo hakusho, kankyo seisaku no atarashii zahyo). Text in Japanese. 486p., June 1972.

The present status of air pollution in Japan and the control policy of public nuisance is discussed. Forty major cities have higher sulfur oxide concentrations than standard values, as high as 40% of the cities subjected to investigation. In addition to SOx, other pollutants such as hydrogen fluoride, chlorine, and hydrogen chloride have complicated the pollution problem. The injuries to human health, such as chronic bronchitis, and damages to agricultural products and forests have become more and more significant. According to the new regulations passed on Jan. 11, 1972, the hourly average particulate concentration for 24 continuous hours must be less than 0.10 mg/cu m, and hourly concentration must not exceed 0.20 mg/cu m. New SOx standards are revised for different districts, and emergency threshold values of all pollutants are also listed. In the nation, 85,487 facilities have been registered as smoke and soot polluters. Restrictions on automobile exhausts have been tightened, and wide district observation systems were established.

42188

Japan Environmental Agency

AIR POLLUTION CONTROL IN JAPAN. 67p., May 1972.

Pollution caused by such substances as sulfur oxides, suspended particulates, and carbon monoxide, for which various countermeasures have been taken have recently shown a tendency to decrease, or at least not to increase. However, with regard to nitrogen oxides and oxidants, for which no regulatory measures have been implemented, the situation has been aggravated resulting in the appearance of new air pollution problems such as the photochemical smog. Damages to property, agriculture, and human health traced to these pollutants as well as to lead, chlorine gas, and hydrogen fluoride are reviewed. The history of regulations on air pollution is described and countermeasures against air pollution are outlined, including the establishment of environmental quality standards and emission control of smoke, soot, and other pollutants. Other measures include pollution control organization at specified factories, relief systems for victims of environmental pollution diseases, countermeasures for photochemical smog including emergency traffic and industrial production curtailments, promotion of fuels with low sulfur content, pollution control measures by local governments, regional industrialization planning and environmental pollution control programs, and limitations on emission from mining, smelting, and refining operations. The monitoring systems for air pollution at the local and national levels are described. Research and development projects currently in progress are listed.

42810

Hashimoto, H.

APPROACHES TO AIR POLLUTION AS INTEGRAL PARTS OF ENVIRONMENT PROBLEMS AND POLICY BY OECD. International Union of Air Pollution Prevention Associations, Proc. Int. Clean Air Congr., 2nd, Washington, D. C., 1970, p. 1341-1342. (Dec. 6-11, Paper P2 D.)

The Organization for Economic Cooperation and Development (OECD), an intergovernmental organization with 22 member states, has been instrumental in the formulation of economic policy and the quality of life, in terms of a livable environment as well as social welfare. With a view to incorporating environmental considerations into economic policy, the Environment Committee within the OECD consists of senior governmental officials with central responsibilities for environmental questions. Prior to the formation of this committee, an air management research group (AMRG) was organized to deal with abatement technology, measurement of air pollution, and effects of air pollution. Results of the abatement technology research indicated priorities in industrialized countries in relation to the automobile, fuel combustion, fluorides, and odors. The measurement panel studied the emerging administrative requirements, examined the present measurement capabilities in member countries, and showed principal areas of deficiency in technical capability in regards to air pollution modelling. Examining research in relation to the technical information needed for administrative decisions in abatement of air pollution, the effects panel defined the categories of health effects, economic consequences, and amenity and long term biological and physical effects. Recommendations of the AMRG include: cost-effectiveness studies of available technology transmission and transformation of air pollutants, research on effects of air pollution, and the implementation of a plan for a project on mass transport of air pollution.

42873

AIR POLLUTION PROBLEMS. (Problem der Luftverschmutzung). Text in German. In: Bericht der Bundesrepublik Deutschland ueber die Umwelt des Menschen. p. 53-61, May 1972.

Problems of and measures planned in West Germany to control air pollution are outlined. Air pollution, particularly due to carbon monoxide, sulfur and nitrogen oxides, fluorine, heavy metals, dust, and odors, represent health and corrosion hazards. Model experiments to elaborate adequate pollution abatement measures have been carried out. Clean air maintenance plans, including regional programs, the set-up and extension of monitoring networks, the use of low-emission raw materials, fuels, technologies, equipment, dust separators, gas cleaning equipment, and high stacks will be the basic means of abating air pollution. Further pollution standards, implying limitations on fuel sulfur content, will be introduced. Partial desulfurization of fuel and Diesel oil has been applied. The emissions from Otto engined vehicles will be successively reduced to 1/10 of the 1969 level by 1980. Carbon monoxide and hydrocarbon emissions have been limited as a first step, followed by a lead emission standard in 1971, requiring a maximum concentration of 0.4 g/l which will be further reduced to 0.15 g/l in 1976. As the possibilities to control emissions from conventional engines are limited, studies on new power sources are promoted. Radioactivity as created by human activity is negligible in comparison with the background level.

42874

AIR POLLUTION CONTROL POLITICS. (Immissionsschutzpolitik). Text in German. In: Bericht der Bundesrepublik Deutschland ueber die Umwelt des Menschen. p. 67-92, May 1972.

Tasks of the different lands in connection with the Clean Air Act, emitted Aug. 1971, as well as short and long-term programs are outlined. The basic activity of the land will lie in enforcement, set-up of expert teams, authorities, and institutions, as well as in the elaboration of regional standards. In Baden-Wuerttemberg, where dust, sulfur and nitrogen oxides, fluorine, and odors are the chief pollutants, the suppression of any further increase in the emissions is a long-term objective. Domestic heating and traffic are the main problems in West Berlin. Continuous air quality monitoring regarding fluorine, hydrocarbons, odorous substances, dust, sulfur and nitrogen oxides, hydrochloric acid, and oxidants is carried out in highly industrialized Northrhine Westphalia where increases in nuclear energy output and intensive growth of the chemical in-

dustry are the basic trends. Abating emissions levels, particularly in the Ruhr area, is the long-term goal to be reached, and emissions from 100 large industrial plants will have to be eliminated or reduced by 1975. Comprehensive air pollution measuring programs are run in Saarland. Measures planned in air pollution, noise and radioactivity control areas in other lands are reviewed.

43007

Douce, W. C.

THE AMERICAN PETROLEUM INSTITUTE S ACTIVITIES IN THE FIELD OF AIR AND WATER POLLUTION ABATEMENT. Oklahoma Eng. Exp. Sta. Publ., no. 97, 23(1):55-61, Dec. 1955.

The American Petroleum Institute has conducted work on pollution problems since 1921. With the formation of the Committee on Disposal of Refinery Wastes within the Division of Refining in 1930, action on waste control in the industry was vigorously promoted. The committee has published a five-volume manual on sources, types, and recommended methods of disposal of refinery wastes and has sponsored fundamental research work on the design of gravity oil-water separators, the effects of refinery wastes on aquatic life, air pollution, and the design of disposal equipment. Revisions of the manual are continually undertaken with many new topics discussed. Current research projects sponsored by the committee concern the applicability of a bio-assay method to natural bodies of water typical of those into which the petroleum refineries discharge wastes, the determination of the effects of long-time exposure to extremely low concentrations of fluorides in the atmosphere, the organization of available information on dust collecting devices, and the critical evaluation of available data on the acute and chronic toxicity for man and animals of selected chemical pollutants found in waste streams from petroleum refineries. In addition, much work has been done by the committee on air pollution, especially in California. With the growth of the petroleum industry, stronger abatement measures appear inevitable; however, final solutions to some of the more complex problems will take time and will be expensive.

44054

Chung, Kyou Chull

AIR POLLUTION AND ITS CONTROL MEASURES IN EUROPEAN COUNTRIES AND THE U.S.A. (Gumi Gakguk eu daegi oyum gwa geu gwanri silate). Text in Korean. Taehan Ulhak Hyophoe Chapchi. (J. Korean Med. Assoc.), 14(10):735-739, Oct. 1971.

Control measures in England started as smoke controls in 1819. Since then many measures have been adopted, such as the Alkali Works Regulation Act (1906), and the Clean Air Act (1956). In the U. S., an air pollution control district was organized in 1947. A U. S. technical conference was held in 1950. The National Air Sampling Network began work in 1953. The Clean Air Act was revised in 1963 and in 1967. Regulations for restricting smoke, other air pollutants, noise, and automotive exhaust have been set up since the Clean Air Committee was organized in 1955 in West Germany. Measures for protecting the public were enacted in France in 1917. In 1963, regulations were enforced to limit smoke, the sulfur content of oil, and auto exhaust. Emission standards in Japan for smoke, dust, and sulfur oxides according to various sources are given. Emission standards for smoke, dust, and sulfur dioxide in New York, Chicago, Los Angeles, England, Germany, and France are listed. Air quality standards in Japan for smoke, sulfur dioxide, and aldehydes and in California for sulfur dioxide, ethylene, hydrogen sulfide, hydrogen fluoride, carbon monoxide, oxides, and particulates are given. West German standards are given for nitrogen dioxide, SO2, H2S, and chlorine. The dust level in West Germany for residential and industrial districts is discussed. Russian air quality standards for SO2, mercury, hydrogen chloride, CO, Cl2, NO2, manganese dioxide, carbon disulfide, fluorine, bromine, and H2S are listed. The air pollution warning level in Los Angeles for CO, oxides of nitrogen and sulfur, and ozone is mentioned.

44598

Largent, Edward J.

FLUORIDES AND CLAIMS OF DAMAGE. In: Fluorosis. The Health Aspects of Fluorine Compounds. Columbus, Ohio State Univ. Press, 1961, Chapt. 13, p. 124-127.

Deleterious biological effects attributed to air-borne fluorides have been reported in Italy, Switzerland, France, Germany, Australia, Norway, England, and the United States. However, there are few readily available records of the claims filed for recovery of alleged damages, of court trials, or settlements made out of court. Claims of damage to plants and animals appeared in almost epidemic numbers along the Delaware River in the Philadelphia area in 1944 and 1945. According to the information available, damage suits growing out of these allegations did not go to trial, and compensation for damage, if any, was made by out-of-court settlements. Since the beginning of this same period of time, a seris of claims of fluoride-induced damage have appeared in Tennessee. One of the results of the allegations of damage or injury caused by fluoride contaminants in the atmosphere has been to stimulate extensive investigations of the biologic effects of fluorides. During the period 1944-1956, important research programs of this type were initiated in New Jersey, New York, Ohio, Oregon, Tennessee, Utah, Washington, and Wisconsin. Court trials have dealt with permissible tolerance levels for fluorides on apples and pears and the use of hydrofluosilicic acid as a preservative in beer. Hearings have been held relative to the use of chemicals in food and cosmetics, and attempts have been made in certain cities to prevent fluoridation of water by the use of injunction.

45783

LEGAL NOTE...LIABILITY FOR AIR POLLUTION. Public Health Rept. (U. S.), 74(2):104, Feb. 1959. 1 ref.

In the case between the Reynolds Metals Company and Vturbide, the plaintiffs claimed they were poisoned by fluorides originating from the plant of the defendant. Their injuries were found by a jury to have been caused by excessive emission of fluorides by the defendant s plant. On appeal by the defendant the court of appeals, sustaining the verdict for the plaintiffs, held that the defendant s evidence of reasonable care in operation of the aluminum reduction plant was not sufficient to rebut the presumption that the excessive emission of fluorides was attributable to the defendant s negligence. A finding that excessive amounts of fluorides were deposited on the plaintiff s property from the plant whose construction, operation, and maintenance was under the exclusive control of the defendant could reasonably be accepted as circumstantial evidence of negligence.

46561

Loewa, Ortwin

MOSTLY PROTEST AGAINST CITY PLANNING. (Meist Proteste gegen die Stadtplanung). Text in German. Umwelt (Duesseldorf), 2(5):38-42, 1972.

Hamburg is trying to get the help of each resident to combat environmental pollution. In order to create a green belt in the city, newlyweds were asked to plant a tree at a point of their own choice. Unfortunately the trees are threatened by automobile exhaust gases. The erection of an automatic air monitoring station at a cost of 1 million dollars is planned, as is the use of electrically driven garbage collection trucks. The planned erection of an aluminum plant in Stade met heavy opposition from public authorities. The emitted gases from such a plant which contain fluorine compounds which would be carried with the main wind direction East to Pinneberg, which has the largest tree nursery of the world. Another aluminum plant in Hamburg itself is scheduled to begin operation in 1973. Because of the regulations concerning fluorine emissions and red sludge, this plant will begin operation at a later date. Eight agencies deal with the protection of the environment. One environmental protection center coordinates information between the agencies. Since Mid-May of this year, an advisory panel of seven representatives of industry, research, and the public has been created, headed by the mayor of Hamburg. A first report by this panel concerning environmental protection will come out in November.

46586

Frankenfeldt, R. E.

COMPARATIVE CONSIDERATION OF THE ENVIRONMENTAL PROTECTION REGULATIONS CONCERNING THE ALUMINUM INDUSTRY IN VARIOUS COUNTRIES. (Vergleichende Betrachtungen der Vorschriften zum Umweltschutz fuer die Aluminiumindustrie in verschiedenen Laendern). Text in German. Preprint, Gesellschaft Deutscher Metallhuetten und Bergleute, Clausthal-Zellerfeld (West Germany), 13p., 1972. (Presented at the Gesselschaft Deutscher Metallhuetten Bergleute-, Hauptversammlung, Stuttgart, West Germany, April 26-30, 1972.)

The countries of West Germany, France, Great Britain, Italy, the Netherlands, Norway, Austria, Sweden, Switzerland, and Spain have laws concerning environmental protection which are of special interest to the aluminum industry. The laws in West Germany are listed as example. West Germany, Italy, Norway, Sweden, and Spain have laws specifically regulating the fluorine emissions. The regulations differ among the various countries. In Germany and in the Netherlands the regulations pertain solely to the emission of gaseous fluorides, this is, hydrogen fluoride. In Norway and Sweden the regulations pertain to both gaseous and particulate fluorine. The maximum allowable emission in the Netherlands is 0.4 kg gaseous F/t aluminum. In Norway the maximum allowable emissions are 1.0 and 2.6 kg gaseous and particulate F/t Al. Gaseous F is damaging to plants and ruminants. The laws and regulations affect only new industrial plants, with the exception of Germany and the Netherlands where already existing aluminum plants may have to comply with the law if its emissions affect the environment in any way. A short-term (0.002 mg gas F/cu m air) and a long-term (0.005 mg F/cu m) maximum allowable value will be issued for West Germany. In Italy the value of 0.020 mg gaseous and particulate F/cu m may not be exceeded during 24-hour measurements and 0.060 mg gas and particulate F/cu m during 30-minute measurements.

47380

Humphreys, Vic

INDUSTRY GUIDE FOR CONTENDING WITH POLLUTION CONTROL STANDARDS. Oilweek (Calgary, Can.), 23(29):16-17, 19, 22, Sept. 4, 1972.

Various Federal and provincial governments in Canada have established environmental departments, regulations, and legislation. Air quality standards have been established for fluorides, hydrogen fluoride, oxidants (as ozone), nitrogen oxides (as nitrogen dioxide), carbon monoxide, ammonia, lead, hydrogen sulfide, sulfur dioxide, dust fall, suspended particulates, and soiling. Emission standards have been formulated for the pulp and paper industry, petroleum refineries, oil and gas production, and many other industries. Water quality standards and noise regulations have also been established.

48719

Gaessler, Willi

EUROPEAN ENVIRONMENTAL PROBLEMS AND SOLUTIONS--AIR POLLUTION. Preprint, 5p., 1972. (Presented at the International Pollution Engineering Congress, Cleveland, Ohio, Dec. 4-6, 1972, Paper 8b.)

Air pollution regulations adopted and proposed for West Germany and for the European Economic Community as a whole are reviewed. Under existing West German laws, licenses are required for the construction and operation of plants and installations that generate large amounts of pollutants. Sulfur oxides emissions will be limited as soon as flue gas desulfurization processes are developed. Maximum emission values will be set or reduced for dusts, SO2, nitrogen oxides, carbon monoxide, hydrocarbons, hydrogen sulfide, and fluorine and chlorine compounds. Limits have been established for CO and HC in automotive exhausts, and gasoline can contain no more than 0.4 g lead/l. Present (1969) and projected (1980) annual emission rates of the major air pollution sources in West Germany are summarized. The European Commission recognizes the need for a common policy in the field of air pollution control and has proposed a number of joint research and development projects. Activities to be carried out in 1973 are described.

48788

Conway Research, Inc., Atlanta, Ga.

GEORGIA: BRIDGING THE GAP BETWEEN ECONOMIC IMPERATIVES AND ENVIRONMENTAL INTEGRITY. Site Sel. Handb., vol. 2:1-16, 1972.

Although the Georgia Department of Industry and Trade administers one of the biggest budgets in the country to attract new industry, the department will work only with firms whose prospective plants in Georgia will meet State and Federal water, air, and noise pollution regulations. In the matter of industrial pollution, the department works closely with the Air and Water Quality Control Sections in the Department of Natural Resources. The 1972 air and water quality standards developed by the two Sections are shown. Enforcement of the standards and regulations governing solid waste disposal is the responsibility of the Environmental Protection Division of the Department of Natural Resources. The 1972 standards tightened the original 1968 regulations, particularly with respect to ambient air standards and particulate matter from fuel-burning installations. New air quality and emission standards were set for sulfur dioxide, smoke, fluoride, and particulate emissions, asphaltic mix plants, Portland cement plants, nitric acid and sulfuric acid manufacturing plants, conical burners, incinerators, and cupola furnaces. Additional standards for fertilizer plants and cotton gins and source monitoring became effective in Sept. 1972. The new water quality standards tightened controls over thermal pollution, dissolved oxygen, and bacteria. State progress in water pollution control, surface mine reclamation programs, pesticide control, and solid waste management is described. Research programs of the Institute of Ecology and the Institute of Natural Resources, University of Georgia, are discussed.

50180

Japan Environmental Agency, Tokyo, Bureau of Atmospheric Safety

INSTRUCTIONAL DATA ON MATERIAL CONCERNING THE ATMOSPHERIC SAFETY BUREAU, FROM THE ALL-JAPAN POLLUTION CONTROL ADMINISTRATORS CONFERENCE. (Zenkoku kogai kankei shukanka(bu)cho kaigi taiki hozenkyoku kankei setsumei shiryo). Text in Japanese. 104p., Feb. 1973.

Countermeasures on photochemical smog, offensive odors, urban air pollution, noise, and vibration are discussed. In 1972, 14 Prefectures issued warnings on photochemical smog, and the numbers of warnings increased in 13 Prefectures except in the Tokyo Metropolitan Area. The total warnings increased from 103 in 1971 to 176 in 1972. Air pollution monitoring networks for automatic measurements of sulfur oxides, nitrogen oxides, hydrocarbons, hydrogen fluoride, hydrogen sulfide, oxidants, ozone, and of metallic particulates were planned. In Dec. 1972, a new limitation for the allowable automotive exhaust gas was issued, and a remarkable decrease of exhaust gas pollution was expected. The environmental standards of some air pollutants in this country as well as in America, Russia, Sweden, Canada, and Czechoslovakia are also given.

52026

Toyama Prefecture (Japan) Public Nuisance Center

ANNUAL REPORT ON POLLUTION CONTROL ACTIVITIES. NO. 1. 1971 AND 1972. (Gyomu nenpo, dai1chigo. Showa 45, 46 nendo). Text in Japanese. 267p., Dec. 1972.

The Toyama Prefecture Public Nuisance Control Center was constructed in June 1970, and further expanded and moved into a newly constructed Prefectural Government Office building in Aug. 1972. The Center comes under the jurisdiction of the Department of Environmental Protection of the Prefectural government. The physical structure of the center consists of an automatic and continuous air pollution monitoring room on the top floor, the pollutant chemical analysis room, the air pollution experimental lab, the standard gas experimental lab, an air analysis room, an odor experimental lab, and various other analysis rooms. There are similar but smaller labs for water pollution and solid waste. The center is staffed by 31 persons. This annual report presents a comprehensive study and statistics compiled by the center including special investigations in various areas with air pollution problems, investigation of fluoride gases, investigation of complaints by questionnaires, measurements of soot, dust, and suspended particulates in various electric furnace areas, inspections of designated factories, measurements of fuel sulfur content, inspections of toxic gas emission facilities, the records of continuous monitoring on settling particles and sulfur oxides, studies on heavy metal pollutants in the air, studies on particulate sizes and crystalizations, and investigations on automotive emissions. The area s suspended particulates average from 0.100 mg/cu m in the busiest center city and factory areas to 0.06 mg/cu m of suburban agricultural areas.

57270

Corley, J. P., D. A. Waite, J. W. Johnston, and L. C. Schwendiman

ENVIRONMENTAL SURVELLIANCE FOR FUEL FABRICATION PLANTS. Battelle Memorial Inst., Richland, Wash., Pacific Northwest Labs., Atomic Energy Commission Contract AT(45-1):1830, 71p., April 1973. 70 refs. NTIS: BNWL-1723

An environmental surveillance program for air, water, and other media is presented for fuel fabrication plants; the program is sufficiently general to cover plants fabricating uranium oxide or mixed uranium and plutonium fuels and is not specific to a particular plant. It provides for surveillance of media believed either to be significant in terms of dose to man or to be potential centers for long-term accumulation of contaminants. Surveillance of the air is treated in terms of equipment and techniques for sampling, quality controls, and the potential for pollution from radionuclides, fluorine compounds, and nitrogen compounds. Regulations and standards for nuclear plants are discussed.

59722

Engineering-Science, Inc., McLean, Va.

FIELD SURVEILLANCE AND ENFORCEMENT GUIDE FOR PRIMARY METALLURGICAL INDUSTRIES. (FINAL REPORT). Office of Air Quality Planning and Standards Contract 68-02-0627, Program Element 2A5137, Rept. EPA-450/3-73-002, 379p., Dec. 1973. 49 refs.

A step-wise enforcement procedure intended for use by state and local air pollution control agencies is presented in manual form. Included are process descriptions, a discussion of emission sources, typical control devices, stack gas and process monitoring instrumentation, and inspectors worksheets for such primary metallurgical operations as the iron and steel, aluminum, copper, lead, and zinc industries. All major operations in each of these are analyzed, including an enforcement procedure for the storage and handling of raw materials. Upset conditions and abnormal operating circumstances are examined in relation to their role in air pollution. Examination of the major pollutants from these five industrial categories provides the most concern for particulates. Sulfur oxides and fluorides are also of concern in specific metals operations. Sections on the inspection of pertinent air pollution control devices are also provided. (Author abstract modified)

60630

Durand, G.

AIR POLLUTION. LAWS - DECREES AND REGULATIONS. SUMMARY AND COMMENTARIES. (Pollution atmospherique. Lois - Decrets et reglements. Resume et commentaires). Text in French. Commission Eau et Pollution Atmospherique, CT/MTP Service 526 67-456, 13p, April 1967.

Clean air maintenance-related laws, decrees, and regulations enacted in France during the last years are reviewed. The Law of Aug. 1961, blaming domestic heating, industries, and automobile traffic for causing air pollution by such substances as carbon monoxide, sulfur dioxide, and fluorine, which are regarded as the most dangerous air pollutants are discussed. The Sept. 1963 Interdepartmental Decree, along with the Aug. 1964 Decree, call for the limitation of combustion-generated air pollutant emissions in special protection zones in urban areas such as Paris. Bans on the use of solid fuels with high volatile contents, and of fuel oils with high sulfur contents hope to achieve this goal in protection zones. Regular inspection of combustion equipment and the employment of qualified personnel are required.

61705

Organisation for Economic Co-operation and Development, Air Management Research Group

REPORT OF THE POLICY PANEL ON ABATEMENT TECHNOLOGY. In: Air Management Problems and Related Technical Studies. p. 163-172, 1972.

The results of a panel on abatement technology are reviewed. The general situation and abatement problems are reviewed in the area of fuel combustion, the emission of fluorides from

primary aluminum smelting and production of phosphate fertilizer, abatement techniques for particulates and odors, and emissions from motor vehicles. Results are presented of a questionnaire listing specific abatement problems, interest in these problems, work in progress, and further research in the countries of the Organisation for Economic Co-operation and Development.

64940

A GUIDELINE FOR THE EVALUATION OF ENVIRONMENTAL EFFECTS (A PROGRESS REPORT). (Kankyo eikyo hyoka no unyojo no shishin ni tsuite (chukan hokoku). Text in Japanese. Kenkocho Kogai Senmon Shiryo (Public Nuisance Gaz.), 9(4):24-35, July 1974.

Standards for environmental protection are based on human health, purity of living environment, and conservation of the natural environment. New environmental standards are required for newly recognized pollutants while existing standards must be reviewed constantly and revised when necessary. Pollutant standards which have been studied include those for hydrocarbons, lead, and fluorides. The most basic condition for evaluating the environmental effect is complete information on pollution sources, population, traffic, and meteorological data. In air pollution evaluation, in addition to sulfur oxides, nitrogen oxides, carbon monoxide, and airborne particulates, predictions of other industrial pollutants must be carried out by diffusion models. Meteorological conditions required for the prediction include average temperature, amount of precipitation, and wind velocity. Air pollution from fixed sources are evaluated by the type of fuel used and their total consumption, and those from moving sources are evaluated by total numbers of vehicles and traffic and road conditions.

66700

Smith, Clifford V., Jr.

OREGON. PROPOSED REVISION TO IMPLEMENTATION PLANS. Federal Register, 39(199):36602-36603, Oct. 11, 1974.

Proposed revisions to the Oregon implementation plans are announced. The revisions establish specific emission standards for fluorides and particulate matter for new and existing primary aluminum plants. For new plants total fluoride emissions cannot exceed 1.3 lb/mo/ton Al or 1.0 lb/yr/ton Al. Any one plant cannot exceed 12.5 ton/mo. Total particulate matter emissions cannot exceed 7.0 lb/ton of Al and an annual average of 5.0 lb/ton Al. Visual emissions from any source cannot exceed 10% opacity or 0.5 on the Ringelmann Smoke Chart. For existing plants, total fluoride emissions cannot exceed 3.5 lb/mo/ton Al or 2.5 lb/yr/ton Al. Any one plant cannot produce 22.0 tons F/mo. Total particulate emissions cannot exceed 13.0 lb/mo/ton Al or 10.0 lb/yr/ton Al. Visible emissions from any source cannot exceed 20% or 1.0 on the Ringelmann Smoke Chart. Regular monitoring and reporting of progress by the sources are required.

67888

Hager, J.

THE LICENSING PRACTICE FOR BRICK KILNS IN BAVARIA. (Aus der Genehmigungspraxis bei Ziegeleien im bayerischen Raum). Text in German. Gesundh.-Ingr., 95(9):253-257, 1974. 10 refs. (Presented at the Second Symposium on Branch-specific Emissions, Fluorine Emissions by Brick Kilns, Munich, Germany, Feb. 1, 1974.)

Brick kilns emit hydrogen fluoride and other fluorine compounds. Injuries to vegetation in the vicinity of such plants have become increasingly known and are due to stacks being too low. Therefore brick kilns have been included in the list of industrial plants which require an operating license. Difficulties arose, however, because fluorine emissions from brick kilns are subject to considerable fluctuations which cannot be foreseen. Therefore a new licensing method was adopted in which a limit concentration of 30 mg F/cu m in the waste gas referred to 3 vol% CO2 is used. The procedure differs depending on whether a stack exists or not. In the case of the existence of a stack, a limit value of the pollutant concentration is determined with the aid VDI (Verein Deutsche Ingenieur)-guideline 2289. In the case of the absence of a stack, a stack height calculation is performed using the mentioned limit value.

73836

Shizuoka Prefectural Government (Japan)

ENVIRONMENTAL POLLUTION CONTROL PROJECT. (Kogai boshi keikaku). Text in Japanese. In: 49 nenban Kogai Hakusho (Environmental White Paper, 1974), p. 335-340, 1975.

The procedure for formulating pollution control plans is discussed. The 5-year pollution control plan for Fuji district (including two cities and four townships) which was put into effect in Dec. 1973 is described. The air pollutant concentration standards are as follows: sulfur oxides, 1-hour value 0.1 ppm and daily average 0.04 ppm; suspended particulates, 1-hour value 0.20 mg/cu m and daily average 0.10 mg/cu m; nitrogen oxides, daily average 0.02 ppm; and hydrogen fluoride, yearly average 0.02 ppm. The present value and target value of water pollution load (biological oxygen demand) for eight rivers and one bay are given. The air pollution control measures to be taken by industries are desulfurization and low sulfur content fuel for SOx, fuel conversion and electrostatic precipitator for suspended particulates, improvement in combustion methods and denitrification for NOx and alkali washing for HF. The pollution control measures to be taken by industries and municipalities for water, noise, and malodor pollution are also described. The total budget for the 5-year plan is $90,000,000 for industries and $70,000,000 for municipalities.

73839

Ehime Prefectural Government (Japan), Div. of Life and Environment

ENVIRONMENTAL POLLUTION IN EHIME PREFECTURE IN 1974: AIR POLLUTION CONTROL MEASURE. (Ehime no kogai: taiki osen boshi taisaku). Text in Japanese. p. 41-78, 1975.

The environmental pollution monitoring, measurement, and control measures based on the Ehime Prefectural environmental control regulations issued in Oct. 1969 and revised in March and July 1971 are reviewed. The environmental standards for sulfur oxides, carbon monoxide, nitrogen oxides, suspended particulate, and oxidant are given. The administrative system for emission control regulations, emission control methods, and emission standards for emission sources and pollutants are described. The total emission quantity control method introduced in March 1974 for sulfur dioxide is described with characteristics of simulation calculation and simulation method. The emission source control for boilers and furnaces is discussed with statistical data. The data on fluorine, hydrogen fluoride, chlorine, hydrogen chloride, and hydrogen sulfide concentrations measured at emission sources are given. The environmental monitoring system, emergency

communication system, and emergency procedures are also discussed. As for photochemical smog, the NOx concentration is constantly monitored at emission sources and oxidant concentration is measured.

76397

Varkonyi, Tibor and Magdolna Kerteszne-Saringer

AIR POLLUTION MONITORING SYSTEM IN HUNGARY. (A legkori levegoszennyezodes ellenorzesenek rendszere Magyarorszagon). Text in Hungarian. Energiagazdalkodas, 16(10):464-466, Oct. 1975.

The national air pollution monitoring system being set up in Hungary under the guidance of the Ministry of Public Health is described. The network will be operated by the Sanitary Epidemiological Stations in cooperation of the National Institute of Public Health. A total of 438 sampling stations will be installed in 28 communities in the first step of the project. The sulfur dioxide, carbon monoxide, nitrogen oxides, fluorides, dust, and dust lead concentrations will be measured. The use of Philips SO2 monitors and URAS CO recorders is envisaged.

76847

Fukuoka Prefectural Government (Japan), Bureau of Public Health

AIR POLLUTION COUNTERMEASURES. (Taiki osen taisaku). Text in Japanese. In: 1974 Environmental White Paper, p. 95-123, Jan. 1975.

Air pollution countermeasures taken in Fukuoka Prefecture, Japan, in accordance with various 1973 air pollution control regulations for sulfur dioxide, carbon monoxide, airborne particulates, nitrogen dioxide, and photochemical oxidants, are reviewed. A telemetry network, covering the entire prefecture, has been in operation since September 1974. Pollutant values in compliance with the new standards were observed at only a few of the monitoring locations. In Fukuoka Prefecture, K values for sulfur oxides range from 4.67 to 17.5, under the standards established on April 1, 1974. Maximum ground concentrations (ppm) are proportional to K values: A K value of 17.5 corresponds to SOx concentration of 0.03 ppm. In Fukuoka Prefecture, at the end of 1973, there were 4612 soot-emitting facilities in 1897 enterprises, registered according to law. Forty percent of the facilities were located in Kitakyushu City. A system of alerts for sulfur oxides and photochemical smog has been established, in cooperation with Kumamoto Prefecture. On-site factory inspections have been conducted for sulfur oxides, soot, and toxic substances. Environmental protection agreements have been made by various Fukuoka cities and industries located in them. Emissions of cadmium (zinc refinery, Omuta City; emission standard, 1 mg/N cu m) hydrogen fluoride (aluminum refinery, Omuta City; total amount standard, monthly average value of emission, based on hourly values, 4.64 kg/H). Wind tunnel experiments and diffusion calculations were conducted in Kitakyushu City and Omuta City. Fuel standards are being established.

76965

GOVERNMENT ORDINANCES TO DECIDE DATE OF ENFORCEMENT OF PARTIAL AMENDMENTS TO AIR POLLUTION CONTROL LAW. GOVERNMENT ORDINANCES FOR THE PARTIAL AMENDMENT OF AIR POLLUTION CONTROL LAW ENFORCEMENT ORDINANCES. ORDER FROM PRIME MINISTER S OFFICE ON THE PARTIAL AMENDMENT OF ENFORCEMENT PROVISIONS TO AIR POLLUTION CONTROL REGULATIONS. (Taiki osen boshi no ichibu o kaisei suru horitsu no shiko kijitsu o sadameru seirei. Taiki osen boshiho shikorei no ichibu o kaisei suru seirei. Taiki osen boshiho shiko kisoku no ichibu o kaisei suru sorifurei). Text in Japanese. Taiki Osen Nyusu (Air Pollution News), no. 87:7-16, March 1975. The text of the order from the Japan Prime Minister s Office (Order No. 71, November 30, 1974) is reproduced. Summaries of two government ordinances and a set of partial amendments to air pollution control regulations to which these ordinances apply are also included. Government Ordinance No. 374 sets the date of enforcement of regulations (Law No. 65, 1974), partially amending the air pollution control regulations, to be November 30, 1974. The partial amendments (Law No. 65, 1974) include the following points: Prefectural governors can establish more stringent schedules for reduction of total amounts of smoke (sulfur oxides) emission, subject to approval by the Prime Minister s Office, in designated pollution regions where maintenance of environmental standards is difficult by present procedures. Prefectural governors can order improvement in smoke treatment installations and order other necessary changes (such as fuel conversion). Fines will be levied for non-compliance. Government Ordinance No. 375 amends Air Pollution Control Regulations Enforcement Order (Ordinance No. 329, 1968) as follows. Types of smoke are defined by their content of sulfur oxides. Part of metropolitan Tokyo is to be included as one of the designated pollution regions. Desired Atmospheric environmental standards for smoke emission should be attained in March 1978, with due regard given to practical aspects of equipment installation and factory operation. Jurisdiction of the Department of Atmospheric Control is enumerated. Misprints in Ordinance No. 329 are corrected. Explanatory excerpts from the Air Pollution Control Regulations (Law No. 97, 1968) and the Basic Pollution Control Regulations (Law No. 132, 1965) are included. According to Law No. 97, smoke, as defined by law, in addition to sulfur oxides and products of combustion synthesis, and decomposition, also includes cadmium, chlorine, hydrogen fluoride, and lead.

77234

Central Council for Environmental Pollution Control (Japan), Planning Committee

LONG-TERM PROSPECTUS FOR PRESERVATION OF THE ENVIRONMENT: AN INTERIM REPORT. p. 1-71, 1974.

Air pollution as well as water pollution and refuse are included in the long-range environmental considerations. Pollution forecasts are made for 1985 for Japan as a whole, with sulfur considered as a typical air pollutant. Pollution forecasts are made for 1980 for various regions of Japan, considering soot and particulates as well as sulfur. The increased public desire for environmental improvement is discussed. A model is used to predict the economic effects of environmental protection. Advances in environmental technology are predicted, including development of an effective carbon monoxide elimination device for automobiles and an economical device for eliminating hydrogen fluorides in 1977, and development of an economical catalyst for eliminating the emission of nitrogen oxides from stationary sources in 1978. Maintaining an environment which protects human health is stressed as the primary objective of environmental planning.

77817

Gilbert, T.

CURRENT CRITERIA FOR THE CONDITIONS FOR THE EMISSION OF GASEOUS FLUORIDE COMPOUNDS FROM BRICKWORKS. (Aktuelle Bewertungsmassstaebe fuer die Bedingungen der Emission gasfoermiger Fluorverbindungen aus

Ziegeleien). Text in German. Ziegelind. (Weisbaden), no. 4:139-141, April 1975. 3 refs.

Emissions criteria for gaseous fluoride compounds generated by brickworks are reviewed as set forth in the Federal German Emission Control Law. A general emission limit of 30 mg fluoride/cu m flue gas is specified at 3% carbon dioxide, a temperature of 273 K, and a pressure of 1013 millibar. Gaseous fluoride emissions of up to 200 mg/cu m exist at various brickworks in North Rhine Westphalia where special control measures are not being used. Over 50% of these uncontrolled operations are emitting fluorides at levels of over 30 mg/cu m. Emission values for hydrogen fluoride are also specified by the clean air regulations.

78484

Vuksanovic, Petar

ENVIRONMENTAL POLLUTION BY INDUSTRIAL GASES CONTAINING FLUORINE. (Zagadenje okoline industrijskim gasovima sa fluorom). Text in Serbo-Croatian. Tehnika, 28(7):1251-1256, 1973.

The origin of the fluorine content of gases, their effect on the environment, and the levels at which they may be tolerated in the atmosphere are described. The Yugoslavian aluminum industry has been expanding rapidly and better information and legislation in this area are necessary. Available data on safe pollution levels are all from other countries and there is disagreement as to the proper limits. The USSR and Czechoslovakia allow 8 mg fluorine per cu mg of air as a permissible 24-hr average. Some Western European industries are allowed up to 7 mg, while the limit in the U. S. is 5 mg. Standards for maximum concentrations at plant sites, methods of measuring emissions and environmental levels, the influence of alum hydration on hydrogen fluoride formation, and effect of pollution on plant life in industrial areas are discussed.

80894

McManus, T.

AIR POLLUTION IN IRELAND. Inst. for Industrial Research and Standards, Dublin (Ireland), Air Pollution Symp. Proc., Dublin, Ireland, 1972, p. 77-97. (March 22.)

There is a dearth of firm information on levels of air pollution in Ireland. The Department of Local Government operates volumetric sulfur dioxide and smoke apparatus in Dublin, Cork, and Galway. The smoke concentration peaks at about 230 microgram/cu m in winter in Dublin, while in summer levels drop dramatically. The E.S.B. has had 28 volumetric SO2 and smoke monitors located around Dublin since 1970. Air pollution levels in central Dublin are significantly lower than the average of British urban areas. Air pollution control legislation in Ireland is discussed. An interdepartmental working party has been set up to produce a draft policy on the control of both air and water pollution. Domestic sources contribute major amounts of pollution in Ireland. The Institute for Industrial Research and Standards has operated an industrial air pollution control service since the middle of 1970. The specific pollutants investigated during the first 18 mo include dust, sulfur dioxide, odors, metals, solvents, smoke, fluoride, cyanide, wet plumes, and carbon monoxide. High stack policies in Ireland will probably be affected by new European standards to control international atmospheric transport of pollutants. A mobile monitor for SO2 concentration was recently introduced.

81220

Buck, Manfred

AIR QUALITY MONITORING IN NORTH RHINE WESTPHALIA. (Luftqualitaetsueberwachung in Nordrhein-Westfalen). Text in German. In: Grundlagen Luftreinhaltung Laermbekaempfung Nordrhein-Westfalen, vol. 2:52-61, 1975. 16 refs.

The principles, status and prospects of air quality monitoring in Northrhine-Westphalia are described. Air quality monitoring serves the acquisition of information on background concentrations as a basis of licensing procedures for planned emission sources, air pollutant concentration monitoring for smog alarm, and for compliance control and for the substantiation of additional emission control measures. At present, there are three hierarchic monitoring networks, including a mobile network for random sampling of sulfur dioxide, dustfall, fluorine compounds, nitrogen dioxide, total organic carbon, and suspended matter at about 4000 sampling sites. This network furnishes data for licensing decisions. Another partly automated network of 71 stations is used to measure suspended matter and heavy metals, e.g., arsenic, and other carcinogenic metals. The mobile stations will be increasingly used for the monitoring of organic substances, e.g., benzene and its homologs, formaldehyde and related compounds. A fully automated real-time telemetric network, comprising presently 15 SO2-monitoring stations, is used partly for the measurement of carbon monoxide, NO2, and nitric oxide. This network furnishes data for smog alarms.

81399

Yamashita, Shuji

ADMINISTRATIVE STEPS. (Gyosei taio). Text in Japanese. Preprint, Japan Society of Air Pollution, Tokyo, p. 222-230, 1975. 11 refs. (Presented at Japan Society of Air Pollution Annual Meeting, 16th Niigata, Japan, Nov. 5-7, 1975, Paper 9513.)

The Niigata Prefectural Administration s policy for environmental pollution, primarily fluoride emissions from the aluminum refineries in the Joetsu area, is discussed. The Joetsu area comprises the Noetsu littoral industrial belt, chiefly heavy chemical industries. The major gaseous fluoride emission, 67 kg F/day, is traceable to the electrolytic furnaces of the aluminum refining process. Legal regulations for fluoride emissions control include the Niigata Prefectural Environmental Pollution Act of January 1970, the Air Pollution Prevention Act of the Ministry of Health and Welfare and the Ministry of International Trade and Industry, promulgated in June 1971, and the Niigata Prefectural Ordinance 52 of December 1971. Agricultural damage has been significantly and rapidly increasing since the aluminum refineries started their operation in the Joetsu area in May 1963, and the cause of the damage has been determined to be fluoride contamination of the air. After several revisions of the regulations for fluoride emissions control, the mean value of the fluoride emission is now restricted to below 1.3 microgram F/cu m/10 day, and the agricultural conditions are gradually improving.

82278

Shimanuki, Mitsujiro and Minoru Yoshida

ATMOSPHERIC POLLUTION CONTROL IN IWAKI CITY. PRESENT SITUATION AND PROBLEMS. (Iwaki-shi no taiki osen taisaku. Sono genjo to mondaiten). Text in Japanese. Koshu Eisei (Public Health), vol. 39:609-613, Sept. 1975. 11 refs.

Industrial pollution problems of regions around Iwaki City (Onahama Harbor) are discussed. Industrial development

began in 1964; pollution control regulations were promulgated in 1970. Fukushima Prefecture and Iwaki City established a joint pollution control center in January 1972. Telemetric monitoring and warning systems are in effect. Photochemical smog and inversion layer monitoring have been undertaken. Standards have been established for toxic substances unique to Fukushima Prefecture (zinc and copper and their compounds; hydrogen cyanide; hydrogen phosphide). Standards stricter than national standards have been established for cadmium and its compounds, chlorine, hydrogen chloride, fluorine, hydrogen fluoride, silicon fluoride, and lead and its compounds. In 1975, Fukushima Prefecture concluded an agreement with 9 enterprises in the Iwaki region, for reduction of emissions of sulfur oxides, from the present hourly level of 2318 cu m to 989 cu m by the end of 1978.

83965

Csinady, Laszlo

RELATIONSHIPS BETWEEN ENVIRONMENTAL PROTECTION AND PUBLIC HYGIENE IN KOMAROM COUNTY (HUNGARY). (A kornyezetvedelem es kozegeszsegugy osszefuggesei Komarom megyeben). Text in Hungarian. Budapesti Kozegeszsegugy, no. 1:16-19, 1975. 11 refs.

General environmental and hygienic problems of Komarom county, Hungary, are reviewed. This county has the highest population density and highest level of urbanization and industrialization in the entire country. Accordingly, the air pollution levels measured in this county are among the highest countrywide. In Tatabanya, a highly industrialized town, the settling dust, total sulfur, and sulfur dioxide concentrations are substantially higher than the hygienic standards. The total sulfur and SO2 concentrations are further increased by domestic heating during the winter months. The fluorine concentrations measured in a 2000 m radius around an aluminum smelting plant exceed the maximum allowable concentrations. The measures taken so far (construction of high stacks, dust separation in industrial plants, neutralization of fluorine-containing waste gases, and liquidation of residential districts near polluting industrial plants) have not been sufficient for a substantial improvement of the environmental quality. The incidence of respiratory tract diseases is above the national average, which may be due to air pollution.

84415

STATUS REPORT. National Research Council Canada, Ottawa, Associate Committee on Scientific Criteria for Environmental Quality, 90p., Jan. 1976.

The status report of the Associate Committee on Scientific Criteria for Environmental Quality is presented. The following priorities are identified for study by the Subcommittee on Air: mixed system involving sulfur dioxide such as SO2 in presence of particulates associated with power plants, SO2 with hydrogen fluoride associated with fertilizer plants, and other special situations; automobile exhaust including hydrocarbons, carbon monoxide, lead, and benzopyrene; and miscellaneous systems not found in the other classes.

M. SOCIAL ASPECTS

68522

Kono, Yasuko, Mitsuyo Tsuda, and Fumikazu Toyoda

FARMERS AWARENESS OF HEALTH IN POLLUTED ENVIRONMENT. (Kankyo osen chiku nomin no kenko ishiki ni tsuite). Text in Japanese. Preprint, Japan Assoc. for Rural Medical Care, 23(3):284-285, 1974. (Presented at tje Japan Association for Rural Medical Care, General Conference, 23rd, Shizuoka, Japan, Oct. 1974.)

In recent years, trees around a ceramic tile factory in a small village in Toyama Prefecture began to die; since the tree damage was concentrated around the factory, the local residents began to question and blame the factory management, and this became a political issue. First, sulfur oxides were suspected, but the measurements were low enough so that the trees would not have been affected. After further search, it was found that fluorine in the glaze had polluted the air of an area of 250 m radius around the factory, and the concentration was as high as 100 ppm in the entire area. This developed into a law suit against the factory management. But when health examinations were given to the village residents, of the total 439 residents of the polluted area, 115 did not receive an examination. This was 26.2% of the total population; to compare their health consciousness with others, 420 residents of control area were invited for examination and 38.6% did not comply. The reasons given were: 24.5% of men and 32.5% of women answered they fel t perfectly healthy, 21.8 of men and 9.1% of women answered that they received examinations elsewhere. This data shows the level of awareness of the resident concerning their health and air pollution. Although there were no symptoms of damage among the people who received a health examination, physicians wished that more people would show more concern about their own health.

N. GENERAL

04212

S. Abe

THE PRESENT STATUS OF AIR POLLUTION. Clean Air Heat Management (Tokyo) 15, (7-8) 7-18, Aug. 1966. Jap.

The present status of air pollution in Japan is given naming the kinds of contaminants and their origin, factors affecting contamination density, and various types of smog. The types of contaminants are: 1) minute particles (less than 1 micron in size) such as found in soot, carbon, ashes, dust; 2) coarse particles (greater than 1 micron in size), as found in dust, ashes, and minerals; 3) reactive substances found in mist, fog, and vapor such as SO2, SO3, H2S, CO2, CO, NO2, N2O3, O3, aldehydes, HCl, NH3, HF, Pb, Hg, Cd, As, Be and 3, 4-benzpyrene. The contaminants originate from factories, chemical plants, power stations, domestic heating, public baths, hotels, laundries, dry cleaning establishments, hospitals, schools, and public buildings. Also discussed are the human factors affecting air pollution such as public awareness and interest, seasonal, weekly, and daily changes in heating and cooking. Meteorological aspects are covered such as wind direction and velocity, turbu- lence, temperature, rain and snow. The types of smog found in New York, London, Los Angeles, Pittsburgh, and Yokkaichi are described. Graphs and tables list symptoms and diseases affecting plants and humans and give the density of dust particles and SO2 in the main cities of Japan. Data on the sulfur content of various oils produced by Japanese refineries and on the number of Japanese automobiles produced is included for information on emission sources of pollutants.

12307

Harris, Robert L., Jr.

AIR POLLUTION. Preprint, Ohio Cooperative Extension Service, Columbus, Ohio Dept. of Agriculture, Columbus, and Ohio Agricultural Council, 16p., 1969. (Presented at the Conference on Pollution Control - Air, Soil, Water, Columbus, Ohio, Feb. 13, 1969.)

After a brief general discussion of air pollution, the interrelationships between air pollution and agriculture are enumerated. Serious effects on agricultural crops and livestock are caused in particular by atmospheric sulfur dioxide, photochemcial oxidants, and fluorides. At the same time, many agricultural operations add to air pollution. Prescribed forest burning, burning of logging debris or for range improvement or seed bed preparation, and burning of crop residues for disease and pest control add millions of tons of particulate matter to the air. Windblown soil, much of which results from agricultural tillage, is distributed through the atmosphere for great distances. Use of pesticides has created an entire range of pollution problems, and agricultural industries such as alfalfa dehydrating, cotton ginning, grain milling, and animal products processing cause serious emissions, often of odorous pollutants. The major elements of the Federal air pollution control program are outlined, including a brief description of the Air Quality Act of 1967, of the designation of air quality control regions, and of some of the problems involved in determining air quality standards and criteria.

14783

Popescu, C.

NEW CONTROL METHODS FOR THE GATHERING AND TREATMENT OF GASES WITH FLUORINE CONTENT FROM ALUMINA ELECTROLYSIS. (Methode noi de control la captarea si tratarea gazelor cu continut de fluor de la electroliza aluminei). Text in Romanian. Rev. Chim. (Bucharest), vol. 20:445-447, July 1969. 2 refs.

By developing new methods of determining the content of NaF, NaAlO2, and Na2SO4 in the wash water used for recovering HF, it is possible to reduce by half the time required for checking the recovery process in the aluminum plant laboratory. Detection of NaF is by titration of a solution adjusted to a pH of 2.7 with Th(NO3)4 in the presence of Alizarine S. The NaAlO2 is titrated with a lN solution of HCl until permanent turbidity is reached, then titrated with bromothymol blue until greenish-yellow. The sulfate is determined by titration with BaCl2 dissolved in acetone or alcohol, in an acetic acid milieu, with Alizarine S as an indicator.

16400

SECOND REPORT OF THE (SWISS) FEDERAL COMMISSION FOR AIR HYGIENE TO THE FEDERAL INTERIOR DEPARTMENT (1962-1967). (Zweiter Bericht der Eidgenoessischen Kommission fuer Lufthygiene zuhanden des Eidgenoessischen Departments des Innern) (1962-1967). Text in German. Bull. Eidgenoess. Gesundheitsamtes, Beilage B, No. 3, 1968. 25 refs.

A survey of the activities of the Swiss Federal Commission for Hygiene, and a list of publications by its members, is followed by a discussion of the sources and the extent of air pollution in Switzerland. Also examined are the dispersion and dilution of pollutants, their effects on plants, animals, and humans, and control technology. In conclusion, existing regulations are reviewed. Domestic heating systems, motor vehicles, and industries are found to be main sources of pollution. In summer, air pollution is negligible in rural areas and in many urban residential areas. In winter, emissions caused by domestic heaters become apparent. On some winter days the SO2 content exceeds 0.3 ccm/cu m. In the vicinity fo some industries, considerable amounts of dust, soot and smoke are accompanied by disagreeable odors. However, no health impairment in humans has yet been reported. Emissions of fluorine compounds have injured plants and animals. Because of demographic and economic developments, it is assumed that the extent of air pollution will increase. Recommended preventive measures include obligatory inspections of heating aggregates, adequate chimneys on each home, regular sweeping of the chimneys, limitation of the sulfur content of fuels for domestic heaters to 0.5%, and centralization of home heating systems. As far as motor vehicles are concerned, highways, when possible, should bypass villages and cities. The flow of traffic in inner city areas should move quickly. Limits must be established for industrial emissions, suitable sites selected for new industrial complexes, and regulations governing domestic heaters standardized.

17260

CHEMICAL ASPECTS OF ATMOSPHERIC POLLUTION. (Les aspects chimiques de la pollution atmospherique). Text in French. Ind. Chim. Belge, 34(9):739-744, 1969. 21 refs. (Presented at a Symposiom Sponsored by the International Union of Pure and Applied Chemistry, Cortina d'Ampezzo, Italy, July 9-10, 1969.)

The symposium papers to be published in the journal 'Pure and Applied Chemistry' covered the following topics: the toxic aspects of atmospheric pollution and recommended limits on concentrations of 24 pollutants; a method of determining the surface area of very small particles; simple methods of separating aerosols by particle size; the influence of certain substances on the transport of hydrohysable ions; the deletorious effect of fluorides on the flora and, indirectly, on the fauna as well; techniques for sampling, isolation, and quantitative analysis of F compounds; different varieties of 'smog'; a method for correcting benzo(a)pyrene determination for the concomitant benzo(k)fluoranthene; polycyclic aromatic hydrocarbons in the exhaust gas of internal-combustion engines; applications of analytic methods for determining polycyclic compounds; several methods of determination of Pb compounds in air; and a survey of the distribution of traces of pollutants in the atmosphere. Oxygen obtained by distillation of liquefied air is polluted by automobile-exhaust and industrial waste gases. The application of the interface electrode of extremely high sensitivity in air pollution studies and the use of mathematical models in air pollution investigations which would reduce the cost and expenditure of time required for an extensive test program were also covered.

20040

Middleton, John T.

AIR POLLUTION THREAT TO FLORA AND FAUNA DOUBLES THREAT TO MAN. Conserv. Catalyst, 2(2):1-3, 1966.

Effect of air pollution on humans, animals, and vegetation in the United States and Canada are reviewed. Pollutants touched on are sulfur dioxide, sulfur, nitrogen dioxide, fluoride, ozone, and peroxyacyl nitrate. Pollution control efforts since passage of the 1963 Clean Air Act, and implications of the 1967 Air Quality Act, are discussed.

20495

Research Triangle Inst., Research Triangle Park, N. C., Engineering and Environmental Sciences Div.

APPLICATIONS OF AEROSPACE TECHNOLOGY IN AIR POLLUTION CONTROL. (FINAL REPORT). NASA Contract NSR-34-004-056, RTI UE-411-3, 65p., June 1969. CFSTI: N69-36186

The Technology Application Team of the Research Triangle Institute, Research Triangle Park, N. C. acts as an information and technology interface between the National Aeronautics and Space Administration and National Air Pollution Control Administration and as a catalyst among the various sources of information involved in the technology. It identifies very specific technology-related problems and prepares air pollution problem abstracts on each specific requirement which describes the problems in a concise manner using functional nondisciplinary terminology. The specifically described problems include automobile drivers performance tests; remote temperature and wind vector sensing techniques for the lower 2 km of the atmosphere; long-term geophysical effects of carbon dioxide and of particles in the 0.2 to 0.5 micron size range; development of advanced pollutant sensors for methane, sulfur dioxide, fluorine, carbon dioxide, total hydrocarbons, carbon monoxide, nitric oxide, nitrogen dioxide, and total oxides of N2; improvement of adsorption and absorption techniques for removing pollutants from carrier gas streams; instrumentation for the investigation of flame chemistry; effect of trace qualitites of metals and impurities on pollutant identity and output in combustion; analytical techniques for the trace metals in combustion effluent and waste gases from metal processing, both in collected particles and in situ; fluidized bed combustion processes; working fluids for Rankine cycle engines; heat transfer to small gas-borne particles; physical consideration in optimizing fuel-air mixture; measuring techniques for air-borne particulates; and gas exchange capacity of lungs. Other problems mentioned, but not specifically described are oder classification and identification; development of advanced pollutant sensors for As, Be, Hg, Ni, NH3, carcinogens, Cl and HCl, H2S, V, ozone, Br, Ce, F, I, Pb, reactive hydrocarbons, and Cd; holographic techniques for measuring particulate flux, and combustion chamber aerodynamics.

21287

MAINTENANCE OF CLEAN AIR. (Reinhaltung der Luft). Text in German. Oel Gasfeuerung, 14(10):1020-1024, 1969.

The major sources of air pollutants are industries, vehicles, and domestic heating. In the industrial sector, power plants, cement kilns, steel plants, and the chemical industry are the primary sources for pollution. Air pollutants may affect humans, animals, and plants. The harmfulness of dusts is determined by their composition, grain size, and shape. Fine dust particles which penetrate into the lungs are particularly dangerous. Soot requires special attention because it may be a carrier of toxic and carcinogenic substances. The most dangerous gaseous pollutants are carbon monoxide, sulfur dioxide, fluorine, chlorine, and unburned hydrocarbons. The federal government is sponsoring a program of air monitoring and research and development; it took legal measures to avoid or reduce air pollution. Large industrial plants must fulfill stringent regulations laid down in the 'Technical Directives for the Maintenance of Clean Air'. The federal law on preventive measures for the maintenance of clean air requires the installation of automatic measuring stations in industrial centers. Automobile exhausts, too, will soon be subject to regulations.

28923

Stern, Arthur C. and Leonard Greenburg

AIR POLLUTION--THE STATUS TODAY. Am. J. Public Health, 41(1): 27-37, Jan. 1951. 21 refs. (Presented at the American Public Health Association, 78th Annual Meeting, St. Louis, Mo., Nov. 2, 1950.)

An increase of attention to air pollution as a nationwide problem was initiated by the emergence in 1945 of Los Angeles smog as a local problem of the first magnituude. By the fall of 1948, Southern California was the center of university, private, and public research in air pollution and the California public had become air pollution conscious. The Donora smog episode aroused the hitherto complacent East at about the same time. Defense research projects and the significance of recent symposia are mentioned. Damage to vegetation by sulfur dioxide, fluoride damage to livestock, other effects on vegetation, and eye irritation in Los Angeles are discussed. The results of the Public Health Service investigation following the Donora episode are summarized. Air pollution standards are cited, as well as meteorological investigations, jet dilution of stack effluents, dilution by turbulent mixing, dust dispersion and prediction of smog, air sampling and analysis,

new tools for sampling, scrubbers, adsorbers, and dust collectors, governmental regulations, Los Angeles control district rules, and smoke abatement.

32254

Nordrhein-Westfalen Arbeits-und Sozialminister (West Germany)

THE SITUATION IN NORDRHEIN-WESTFALEN IN 1970 AND DEVELOPMENTAL TRENDS. (Situation in Nordrhein-Westfalen 1970 und die Entwicklungstendenzen). Text in German. In: Reinhaltung der Luft in Nordrhein Westfalen, Essen, West Germany, Brinck and Co. KG, 1969, p. 75-83.

The population density of the industrial regions of the state is 1300 to 3000 inhabitants per sq km. These regions are the home of 90% of all coal mines, 70% of the steel industry, 50% of the heavy chemical industry, and 35% of the refineries in all of West Germany. To the emissions from these industries must be added those from 5.5 million households and from 3.5 million automobiles. Since the introduction of mandatory certification of polluters, air pollution in the entire area has decreased markedly. The projection for SO2 emission in West Germany is that it will increase by about 25% until 1975 and from then on will decrease because of the construction of nuclear power plants. In the U. S., in contrast, SO2 pollution will double until 1980 because of widespread use of coal. Pollution trends will be further affected by the growth rate of the chemical industry, which will expand from an index of 100 in 1962 to an index of 320 in 1975. The importance of SO2 as a pollutant will diminish to be replaced by fluorine, hydrocarbons, chlorine, and odorous emissions. The emission of fine dust as a health hazard will increase and dust fall measurements will have to be supplemented by dust concentration measurements. The problem in the steel industry will be fine dust control; in the aluminum industry, fluorine emission control; in steam power plants, fine dust control; and in domestic heating, nitrogen oxide control. Pollution from automobiles is expected to increase until 1975, especially from nitrogen oxides.

37027

Gall, D.

THE WORKING PARTY ON AIR POLLUTION - EUROPEAN FEDERATION OF CHEMICAL ENGINEERING. International Union of Air Pollution Prevention Associations and National Society for Clean Air, London (England), Intern. Clean Air Congr. Proc., London, England, 1966, p. 267-268. (Oct. 4-7, Paper VIII/3.)

The organization, composition, aims, and activities of the Working Party on Air Pollution of the European Federation of Chemical Engineering are described. The field of activity lies in problems of air pollution arising from carrying out chemical processes and in the removal of noxious or offensive constituents produced in such processes. The current status of progress in controlling emissions, including grit, dust, sulfur dioxide, nitrogen oxides, and fluorine compounds, is noted.

44066

Turk, A., D. Turk, and D. T. Wittes

AIR POLLUTION. In: Ecology; Pollution; Environment. Philadelphia, W. B. Saunders Co., 1972, p. 79-108. 8 refs.

Various aspects of air pollution are reviewed. Expressions of concentration for gases and particles are explained. The components of pure air are described and a definition of polluted air is presented. The sources and effects of the following pollutants are discussed: carbon monoxide, carbon dioxide, hydrocarbons, sulfur dioxide, sulfur trioxide, sulfuric acid, nitric oxide, nitrogen dioxide, ozone, oxidants, hydrofluoric acid, and viable and nonviable particulate matter. The effects of air pollution include reduction of visibility and other atmospheric effects, damage to vegetation, direct effects on man, injury to animals, and deterioration of materials. Pollution control measures include filters, cyclones, electrostatic precipitators, scrubbers, adsorption on activated carbon, and incineration. Methods for reducing sulfur dioxide emissions include change of energy sources, fuel desulfurization, emission control devices, more efficient methods of fuel combustion, encouragement of less fuel use, and decreasing the rate of population growth. Problems involved in the switch-over from gasoline-driven to battery-operated automobiles are discussed.

46820

Wende, E. and F. Bister

AIR POLLUTION ASSOCIATED WITH CIVILIZATION. (Zivilisationsbedingte Luftverunreinigungen). Text in German. Z. Allgemeinmed., 48(14):665-673, May 1972.

In the Federal Republic of Germany, the principal sources of emissions are households, industry, and automotive traffic. The volume of these emissions rises every year at approximate average rates of 7, 5, and 3%, respectively. The most significant gaseous emissions are sulfur dioxide, hydrofluoric acid, nitrogen oxides, carbon dioxide, carbon monoxide and hydrogen sulfide. The finer dusts are more noxious, since upon inhalation they can penetrate into the lungs. The effects of benzopyrene and lead as dust or in aerosol form, the history of the several past smog catastrophies due to weather inversions in polluted areas, and mortality in relation to air pollution are discussed. Regular sampling and analysis of air is needed. Control methods include modifying technology, eliminating pollution in stack gases, or dissipating emissions by the use of chimneys. Control equipment includes filters, washers, and collectors. West German regulations and recommendations for the preservation of clean air are mentioned.

49170

Ortega Torres, J.

CONTAMINATION OF THE ATMOSPHERE. (Contaminacion Atmosferica). Text in Spanish. Am. Med. Acad. Ciencias Med. Cataluna, 58(2): 147-165, April 1972. (Presented at the Asociacion de Microbiologia, Higiene y Medicina Preventiva, Dec. 17, 1971.)

The air pollution phenomenon is discussed in terms of definitions, causes, effects on human health and economy, control, and reevaluation of certain attitudes of modern man. The main air pollutants such as sulfur dioxide, hydrogen sulfide, hydrogen fluoride, nitrogen oxides, aldehydes, carbon monoxide, and polynuclear hydrocarbons, resulting from combustion of sulfur-containing fuels, petroleum refineries, aluminum producing plants, fertilizer manufacturing, and traffic are reviewed. The photochemical mechanism of smog formation is discussed along with the meteorological and orographic factors involved in enhancing the process. The air pollution-induced pathology is reviewed and illustrated by the classical episodes recorded in the Meuse-Valley at Donora, at the Baltic Sea, and in Mexico. Los Angeles is referred to as the city with 262 days/yr of thermal inversion incidence. Air pollution monitoring in terms of sampling and analytical methods is discussed along with control possibilities. The latter are reviewed in terms of fuel improvement, combustion process improvement, technological process modifications, and emission control treatment. All the aspects involved in the air pollution control process should be supervised by appropriate administrative

authorities. Maximum local autonomy should be given in terms of correlating the source with the orography and the climatology and the possibilities of controlling pollution. Special associations should campaign in educating and in trying to explain the real hazards caused by pollution. Because of the wide range of unknowns involved, national and worldwide cooperation between science, technology, industry, economy, and law should be established. The modern man should become aware of the threat to the environment caused by affluent living and try to save the environment before its deterioration becomes irreversible.

50748

Japan Environmental Agency

PRESENT STATE OF AIR POLLUTION COUNTERMEASURES. In: Quality of the Environment in Japan. 1972, Chapt. 1, p. 54-80.

Although air pollution in Japan, with the exception of nitrogen oxides, has generally abated, it is still a severe problem. There are 40 cities which do not meet the environmental standard for sulfur oxides; they comprise a little less than 40% of the 110 cities with monitoring stations. The air pollution problem in local districts has recently become aggravated by the increases in such hazardous pollutants as hydrogen fluoride, chlorine, hydrogen chloride, and oxidants. The primary cause is a sharp increase in energy consumption. Air quality with respect to SOx suspended particulates, NOx, carbon monoxide, oxidants, and hydrocarbons are discussed. Environmental and emission standards and air pollution control measures are reviewed.

50867

Hishida, Kazuo

INTRODUCTION TO AIR POLLUTION. (Kogai gairon). Text in Japanese. PPM (Japan), 4(4):2-20, April 1973.

Air pollution is discussed in general. Data on sulfur oxides, suspended particulates, dust fall, and nitrogen oxides in Japan are discussed. The automatic monitoring system for Japan, automobile exhaust pollution in terms of carbon monoxide pollution in Tokyo and photochemical smog, pollutant sources, toxic effects of pollution, and air pollution episodes are also mentioned. The effects of sulfur dioxide and fluorides on vegetation are outlined. Local and national programs and legislation for controlling air pollution are reviewed. Desulfurization of fuels oils and other control methods are briefly mentioned. Enforcement of legislation and monitoring systems are discussed.

51942

Olschowy, Gerhard

ENVIRONMENTAL PROTECTION A TASK OF SCIENCE, PLANNING AND PROTECTION. (Umweltschutz als Aufgabe von Wissenschaft, Planung und Verwaltung). Text in German. Ber. Abwassertech. Ver., vol. 25:17-31, 465-466, 1973. (Presented at the Abwassertechnischen Vereinigung e.V., Main Meeting, Kassel, West Germany, Sept. 8, 1971.)

The present day pollution of the water and air in the Federal Republic of Germany is discussed. Solid waste disposal problems are mentioned. More than 300 chemical compounds and physical substances are known to be air pollutants. Of the gaseous pollutants, sulfur dioxide assumes the largest portion. Fluorine compounds are rarer in the atmosphere than SO2, but they are far more toxic. While the threshold concentration for SO2 is 0.5 mg/cu m air (0.2 ppm), it is 0.01 mg/cu m air for fluorine. The combination of several pollutants, primarily of waste gases with dusts is particularly dangerous, which is further compounded by temperature inversions. In the Ruhr area the haze caused by air pollution reduces solar radiation by about 30%. This haze absorbs particularly the important ultraviolet radiation. A considerable amount of air pollution stems from traffic. The Federal Republic of Germany presently has 16 million cars which produce 25 billion cu m of waste gas. The numerous combustion processes with fossil fuels such as coal and oil lead to changes of the composition of the atmosphere. Global carbon dioxide emission rose between 1950 and 1963 from 700 billion tons to 1100 billion tons, of which about 50% remain in the atmosphere.

52010

Marier, J. R.

THE ECOLOGICAL ASPECTS OF FLUORIDE. Fluoride, 5(2):92-97, April 1972. 21 refs. (Presented at the International Society of Fluoride Research, Annual Conference, 4th, Hague, N. L., Oct. 24-27, 1971.)

The ecological aspects of fluoride are reviewed. Sources of fluorides, fluoride distribution, and final deposition in air, soil, and water are mentioned. Vegetation can be an environment for fluoride, but it can also serve as one of the modes of transport for fluoride uptake by other forms of life. In this way, biological transfer occurs, and food chains are built, increasing the air pollution problem. It is further complicated by recourse to fluoride-containing fertilizers, insecticides, and mineral supplements for livestock. Fluoride burden is also increased from sources such as food and beverage processing, and fluoride- containing aerosols and pharmaceuticals.

63463

Stone, Ralph and Herbert Smallwood

INTERMEDIA ASPECTS OF AIR AND WATER POLLUTION CONTROL. Environmental Protection Agency, Washington, D. C., Office of Research and Development, Contract 68-01-0729, Program Element 1H1093, EPA-600/5-73-003, 357p., Aug. 1973. 411 refs. GPO

On the basis of emission quantity, toxicity, and current conditions, the air pollutants sulfur oxides, sulfur compounds, nitrogen oxides, nitrogen compounds, heavy metals, particulates, carbon monoxide, hydrocarbons, fluorides, hydrogen chloride, arsenic, hydrogen cyanide, ammonia, and ethylene are discussed and classified according to the Standard Industrial Classification Code. The interaction and transport between air and water, sources, treatment, and fate of these pollutants are discussed. The environmental impacts, main sources, and control methods are discussed in detail for each pollutant. Mathematical models are given for various control strategies, cost information, and choice of control program. Intermedia pollution management in the city of Los Angeles is discussed in detail.

63776

Gilbert, T.

SIMPLIFIED METHOD FOR THE CALCULATION OF MINIMUM CHIMNEY HEIGHTS IN CASES OF EMISSION OF GASEOUS FLUORIDE COMPOUNDS FROM BRICKWORKS. (Vereinfachtes Verfahren zur Berechnung der Schornsteinmindesthoehen bei der Emission von gasfoermigen Fluorverbindungen aus Ziegeleien). Text in German. Ziegelind. (Weisbaden), no. 4:152-154, 1974. 7 refs.

A simplified pragmatic method for the determination of the minimum stack heights in brickworks emitting gaseous fluorides is presented with respect to the problems involved in the application of the diagram given the Clean Air Manual to

the calculation of the minimum stack height in such cases. The ground-level fluoride concentrations were evaluated for the immediate vicinity of the emission source under most unfavorable meteorological conditions. The wind speed and the evaluation period were 3 m/sec and 30 min, respectively. In view of the mainly rural location of brickworks, it is not expedient to use the dispersion parameters determined for urban conditions.

64545

Detrie, J.-P.

STUDIES AND RESEARCH ON THE MEASUREMENT OF NUISANCES, THEIR EFFECTS AND THEIR PREVENTION. PROBLEMS OF SPACE PLANNING. (Les etudes et recherches sur la mesure des nuisances leurs effets et la prevention. Problemes d amenagement territoire). Text in French. Apave, 52(175):57-62, 1971.

Studies on the generation, effects, measurement, dispersion, and prevention of air pollutants in France are surveyed. The effects of particulate, unburned matter, and asbestos on lung tissues; effects of carbon monoxide, sulfur dioxide, and exhaust gases on animals; and the effects of SO2 and fluorine compounds on plants are being studied. Shell-Bacharach opacimeters and automatic recording instruments adopting the beta-ray attenuation principle for dust captured on filter are available for the measurement of smoke emissions. The ground level concentrations of combustion process-generated air pollutants are measured by means of S.F. (Smoke-Sulfur) measuring instruments. The dispersion of air pollutants is studied by hydraulic models. Fuel and flue gas desulfurization processes are being studied, partly on a semi-industrial scale. The implementation of emission standards and the introduction of improved firing techniques have resulted in a considerable abatement of the SO2 and smoke concentrations both in Paris and London for the last 10 years.

64937

Hishida, K.

THE OUTLINE ON ENVIRONMENTAL POLLUTION. (Kogai gairon). Text in Japanese. PPM (Japan), 5(5):2-22, May 1974.

Wide area pollution generally refers to environmental pollutions such as smog and other air pollutants caused emissions from mobile sources. Pollutants such as stack gases emitted from specific factories are called local pollution. Primary pollutants can react together to form pollutants, also affect humans and plants. There are four techniques to reduce air pollution. Low-sulfur fuels can reduce the amount of sulfur oxides emitted by combustion. Generation of noxious materials can be controlled by efficient combustion of fuel. Dust collectors and other control equipment reduce noxious materials. The pollution concentration above the ground can be controlled through a diffusion by high chimneys. The diseases caused by environmental pollution include respiratory diseases such as chronic bronchitis, bronchial asthma, asthmatic bronchitis, and emphysema. Poisonous gases affecting plants are sulfur dioxide, sulfur trioxide, hydrogen fluoride, chlorine, hydrogen chloride, ammonia, hydrogen sulfide, and nitrogen dioxide, among which SO2 causes most plant damage.

65407

Berge, Helmut

AIR POLLUTANTS IN THE KOELN AREA. (Luftverunreinigungen im Raume Koeln). Text in German. Allg. Forstz., 20(5):51/52):834, 836-838, Dec. 1965. 5 refs.

An evaluation is presented of systematic air pollution monitorings conducted in the Koeln area in West Germany. The strong influence of industrial emission sources outside the city on air pollution levels measured in Koeln was noted. Except for streets with heavy, slow traffic and frequent traffic jams, other parts of the Koeln area were characterized by very low concentrations of polycyclic aromatic hydrocarbons. Phenols caused reversible acute and chronic damages to the environment, while mercaptans were detected in concentrations high enough to cause irreversible chronic and acute changes in the living environment. Sulfur dioxide, hydrofluoric acid, hydrogen sulfide, nitrogen oxides, and particulate matter in general, and soot in particular, inflicted serious damages on plants and woods. The separation of industrial and residential areas, especially by green belts, is an essential principle of modern space planning.

66718

Hermans, K. H.

DETERMINATION OF ENVIRONMENTAL POLLUTION-GENERATED DAMAGES. (Het vaststellen van schade door milieuverontreiniging). Text in Dutch. In: Milieubalans van Nederland. J. J. Muickhuyse (ed.), Amsterdam/Brussels, Intermediair, 1972, p. 117-128. 18 refs.

General problems of damages afflicted by pollution and contamination to the natural environment, and methods for their determination are described. The detection of damages caused by pollution is complicated by the fact that pollutant levels below a certain limit generate invisible damages. The potentiality of damage is characterized by the tolerance of the living organism or the absolute or relative maximum allowable concentration. Plant damages caused by air pollutants can be determined by systematic pollution monitoring and by aerial photographs. Extensive damages in coniferous forests from sulfur dioxide, fluorine compounds, peroxyacetyl nitrate, and peroxybutyryl nitrate were observed in Europe.

66750

Flower, Franklin B.

EFFECTS OF AIR POLLUTION ON THE ENVIRONMENT. In: Air Pollution and Industry, R. D. Ross (ed.), New York, Van Nostrand Reinhold Co., 1972, Chapt. 2, p. 18-78. 194 refs.

The effects of air pollution on the environment are reviewed with particular emphasis on mechanism of cause-and-effect relationships and socioeconomic implications. Topics discussed include: air pollution effects on materials deterioration; acute and chronic effects on human health, with particular reference to specific industrial emissions; pollution effects on animals and vegetation; and meteorological implications involving global air temperature and urban effects on fog, precipitation, solar radiation, and visibility, with a relationship being given for the effect of atmospheric particulate loadings on visibility. Types of pollutants examined include: metallic and nonmetallic particulates, sulfur oxides, photochemical oxidants, pollens, aldehydes, ammonia, nitrogen oxides, aliphatic and aromatic hydrocarbons, asbestos, carcinogens, pesticides, odorous compounds, inorganic acids, chlorine gas, radioactive substances, carbon monoxide and carbon dioxide, hydrogen sulfide, fluorides, ozone, and peroxyacetyl nitrate.

69692

Gilbert, T.

A SIMPLIFIED METHOD FOR CALCULATION OF THE MINIMUM STACK HEIGHT AT EMISSIONS OF GASEOUS FLUORINE COMPOUNDS FROM BRICK KILNS. (Ein

vereinfachtes Verfahren zur Berechnung der Schornsteinmindesthoehen bei der Emission von gasfoermigen Fluovoverbindungen aus Ziegeleien). Text in German. Gesundh.-Ing., 95(9):257-258, 1974. 7 refs. (Presented at the Second Symposium on Branch-specific Emissions, Fluorine Emissions by Brick Kilns, Munich, Germany, Feb. 1, 1974.)

A new pragmatic procedure for the calculation of stack height for brick kilns uses, aside from the guideline VDI (Verein Deutsche Ingenieur) 2289 and No. 2.6 of the Technical Directives for Clean Air Conservation (TALuft), the following conditions. The emission conditions are evaluated in the vicinity of the source only under the unfavorable condition of the rarely occurring labile stability class V by Klug. In a first coarse approximation it is then assumed that the emission conditions under other stability conditions are better. For the wind velocity, the average velocity in the waste gas plume of 3 m/sec is used. For the emitted concentration of fluorine compounds, the 60% value of the recommended maximum allowabe short-term emission concentration of 5 micrograms F/cu m, i.e. 3 micrograms F/cu m, is inserted into gas plume incrementation the method of Briggs was used. The point of the theoretically anticipated emission was used for the calculation. A numerical example is presented.

AUTHOR INDEX

A

ABBANAT, R A *G-04927
ABE E H-48556
ABE Y A-52277
ABE, S *N-04212
ABEL E D-14066, H-23579
ABEL, E D-07579
ABELES, F B *H-11100
ABKEWITZ I G-28019
ABLE E D-13838
ABURAMOTO Y B-58380, *C-84175
ACHORN F P *B-37914, *B-81944
ADAMS D F C-22879, *C-23947, *C-24279, *C-24399, *C-25647, *C-25816, *D-23760, H-09683, *H-17684, H-20015, *H-20400, H-22284, *H-23794, *H-24402, *H-24566
ADAMS F W H-45663
ADAMS, D F C-00126, *C-03550, *H-03549, H-03570, H-03571, H-03572, H-05585
ADAMS, W R G-01047
ADHAMI G F-41543
ADLER A D *G-78873
ADLER P *G-28556
AFANAS YEV M M F-21632
AGATE J N *G-15040
AHMED M G F-81069
AIZAWA E D-69744, G-49607, G-76902, H-65715, *H-77421
AIZAWA I D-58339
AKASHI, S *G-04145
AKIYAMA T E-49185
AKLAND G G D-58218
AKULICH S S *B-66618
ALARY J A-46119, A-70727, H-29991, H-46997
ALARY, J C-13056
ALENGRIN F A-46119, H-29991, H-46997
ALLCROFT R *H-13213
ALLEN I W D-23760
ALLEN N *C-39239, *C-39243
ALLEN R C-06397
ALLEN R K H-56788
ALLMENDINGER D F *B-28889, C-26909, H-18704, H-26691
ALPAUGH E L *G-16916
ALQUEZA E N H-47385
ALTMAN, A G-01728
ALTSHULLER A P *C-05914
AMANO S H-64824
AMBROSI L G-14319
AMBRUS J A-17116
AMBRUS, J A-06241
AMICK R S A-09651, *A-09693, A-65064
AMIROV R O *H-23188
AMTOWER R E C-18016, C-24966
ANDERSON D M A-40159, B-44979
ANDERSON F K H-15501
ANDERSON P L *C-81439
ANDO A *D-58427, *D-71362
ANDO H G-81181
ANDO S H-74459
ANDRES R H A-35985
ANIKEYEV V A B-41932
ANTIPOV V G *H-23295
ANTONELLI G *G-32152
ANTONELLI, G *G-11444
ANTWEILER H *G-84260
ANZAI K A-52277
AOKI T *B-83198
APPLEGATE H G G-30385, G-30387, H-24402
APPLEGATE, H G *H-03570, *H-03571, *H-03572, H-03729, H-06681
APSIMON H E-64013
ARAI M C-12451
ARAKAWA H A-58402, B-58380
ARAKAWA T C-12451
ARIKADO H H-61410
ARITO H G-45683
ARKHIPOVA L N *B-32384, B-58632
ARMSTRONG W D G-28556
ARMSTRONG, W D G-09575
ARNDT U *H-19703, *H-32854, *I-63139
ARTALEJO J G-84137
ARTHUR A M H-79129
ARTHUR C E A-50242
ASAGINO K C-12451
ASAI C H-84548
ASAI T H-82498
ASCHBACHER P W *H-43226
ASHENBURG N J G-33276
ASHTON J T *F-19175
ASO *B-72038
AUERMANN E A-53751, *E-44277
AUGE, R G C-06352
AUTIAN J *G-24153
AVY, A P *A-03129
AYER F A J-30696

B

BABAYANTS R A *G-11942
BADOZ LAMBLING J *F-41543
BAETGE H H H-45467
BAEVSKII V A B-37544
BAILEY D L R *C-34126
BAILEY J J *C-23517
BAIULESCU G *A-30517
BAKER B B JR *C-83592
BAKIROV U K A-68807
BAKR M Y *B-51720
BALABAEVA L *D-47982
BALABAJEWA L *G-70519
BALADI E *A-76152
BALAY H L B-81944
BALAZOVA G A-17116, *G-13700, *G-14112, G-14126, *G-19880, *G-37569, *G-37684, *G-52686, *G-62596, *H-25665
BALAZOVA, G A-06241, *G-10203
BALAZOVJECHOVA, L G-10203
BALDACCI E *H-24035
BALL D F *B-30519
BALL, K E *C-06279, C-06494
BALLANTYNE D J *H-39098
BALOGH E *A-68703
BARBER J C *B-24834, B-25038, B-32232, B-36405, *B-81040
BARDELLI, P *H-12529
BARETINCIC J M H-42946
BARIBAULT R P *A-58939
BARKER D B *C-79843
BARNEA M *G-38616
BARNES D P C-06397
BARNES R L H-78058
BARNEY J E II C-26485
BARTELL R P A-19400
BARTELS O G *E-40271
BARTHOLOMEW, M D G-06497
BARTLE E R *C-41489
BARTLETT J C *C-24331
BARTOSOVA, L A-06241
BATEMAN, G Q H-04925
BAUM F *A-40471, *H-68122
BAUMEISTER W *H-28483
BAURHENNE G *B-68795
BAYLES B B H-23222
BECK A R H-72762
BECK D A *K-84395
BECK H B-38445
BECKER K H *A-29786
BECKETT R R G-28139
BECKMAN O K B-52179
BEHRENS D *B-51845
BEISING R *A-61800
BEJAOUI M G-84236
BEKTUROV A B *A-76411
BELAGA M B *A-17076
BELAGA, M B *A-04068
BELKNAP H J *L-24481
BELL C D *A-09695
BELL D D *A-08748
BELL G B C-22812
BELL G H G-15040
BELL M E G-28556
BELYAEV V A G-59073
BENDER R J *B-29680
BENEDICT H M C-25487, C-26400, *C-27430, *H-35613, *J-43547, *J-44672, *J-67865
BENEDICT, H M C-00260, C-00264, C-01793, C-04038, *C-05586, *H-00187, *H-00265, *H-00266
BENESI H A *F-18427
BENGER M *B-26908
BENNETT J H *H-45009, *H-56204, *H-71931
BENNETT R L *C-83442
BENSON, N R *H-03860
BENSON, S W *F-01677, *F-03062
BEREZINA L P B-41932
BERGE H *A-80507, *H-45022, *H-56584, *H-73172, *N-65407
BERGER U A-39635
BERGMANN K A-48946
BERINDAN C *B-19571
BERLY E M *B-24110, *B-35448
BERLYAND M YE *C-48392
BERNARD M L *C-45344
BERNATZKY A *B-45468
BERNHART A P *A-34018
BERNITT, D L *F-04674
BERNSTEIN L H-45540
BERNSTEIN S B-12127
BERRY C R *H-17697, *H-74624

BERRY W L *G-71933
BERRY, C R H-03676, *H-05560
BERTOLACINI R J *C-26485
BERTRAND R R *J-42746
BESTUZHEV A S F-21632
BETHEA R M *A-71262, B-12465, C-23162
BETTS W E D-52811, H-70607
BETZ H B-37509, B-54310
BEWERS J M *C-17117, *E-78933
BHUSSRY B R G-28556
BIELER B H B-61954
BIENSTOCK D B-33554
BIERSTEKER K *G-16345
BIERSTEKER, K *K-11414
BIHELLER J *C-28374, *C-29887
BILLINGS, C E *B-07552
BINGHAM F T H-20573, *H-27030
BINGHAM T E J-30696
BINI G *J-30226
BIRKLE M *C-65846, *C-66606
BIRSE E A B *A-31283
BISCH A H-51271
BISCH A M H-62597
BISSELLE C A *K-69550
BISTER F N-46820
BITTEL R *G-49448
BJORSETH O C-49476
BLAKE H E *B-43972
BLAKEMORE F *H-39493
BLAKESLEE H W *C-66753
BLANK Y I F-21632
BLIGNY R H-51271, H-63167
BLOKKER P C *K-27010
BLOSSER E R *D-52578
BLYUM I A *C-27131
BOBBIO G G-40635
BOCKMAN O K C-52206
BODDIE G F G-15040
BOEHLEN B *B-23370
BOEHLEN, B *A-12622
BOEHM E *B-81995
BOEHME J B-78890
BOER W *L-31492
BOERNGEN J G A-68912
BOERTITZ S A-53751, H-38332, *H-48798
BOGAYEVSKIY O A A-68807
BOGDANOVA N S B-37745
BOGDANOVIC, S B H-12540
BOGORAD G I *C-36125
BOGUSLAVSKIY I M B-37745
BOHLANDER R F *C-19076
BOHM E *B-64506
BOHN H L *H-51526
BOHNE H *H-45160, *H-45474, *H-52574, *H-57475, *H-64860
BOHNE, H *H-11466
BOLAY A H-15604, *H-17892, *H-23576, *H-24395, H-28446, *H-32536, *H-32539
BOLDT K R *A-81861
BOND, A M *C-09560
BONDAREVA E N D-17642
BONN A Y C-36125
BONTEMPS A H-63167
BOOHER W B A-57231
BORENSTEIN, M *B-07815
BORISENKO N A A-42731
BORKOWSKA M *C-52101
BORSDORF W *G-48030
BOSSAVY J *H-24933, *H-39183, *H-44411, *H-48413, *H-74617
BOSSAVY M J *H-23852
BOSSAVY, J *H-02049
BOSSAVY, M J *H-01557
BOULET M G-28037
BOURBON P *A-46119, A-70727, *D-39182, *H-29991, *H-46997
BOURBON, P *C-02042, *C-13056
BOVAY E H-15604, *H-15838, H-17892, H-23576, *H-23950, H-24395, *H-28446, H-28474, *H-28475, *H-32535, H-32536, H-32539, H-32897, H-33606, *H-49561
BOWLER R G G-15040
BOWNE, N E E-02325
BOYD, G A-07650
BOYEV I YA *C-41064
BOYSEN J E *G-27895
BRAKHNOVA I T *A-81169
BRANDT A D *A-40159, *B-44979, C-27294
BRANDT C S C-16969, *H-12415, *H-24358, *H-26861, *H-29206, *H-30473
BRANDT, C S *H-03472
BRANTNER H C-44174, C-44177, G-12987, G-14477, *G-31234
BRASH M P A-48116
BREDEMANN G *C-18230, *C-33929, *H-23639
BREEN, W H C-05586
BRELL H A-40471
BRENNAN E H-12155, H-14968, H-26717, H-42958, H-70984, H-80493
BRENNAN, E H-01800, H-06557
BRENNAN, E G H-03873
BRENT F D N G-37791
BRESSAN D J C-51599, *D-62438, E-30126, E-43424
BREUSOVA G N A-76411
BREWER L W G-27753
BREWER R F *H-16472, *H-16896, H-54910
BREWER, R F H-03612, H-03616, *H-04403, *H-04672, *H-05324, *H-05667
BRIDGE A C *B-38299
BROCKE W A-40401, *A-61007, *A-69422, B-50937, B-51101, B-61259
BRODOVICZ, B A *K-08420
BRONSCH K *H-10841, H-10843
BROOKS J J C-69152
BROOKS J N C-79843
BROWN G H-32736
BROWN H *C-23767, *C-40211
BROWN R M *E-78793
BROWNLEY F I JR *C-23654
BRUN M J *K-68[illegible]2
BRUNE D *C-11626
BRYAN R J *A-76190
BRYANT G W *F-18863
BRYKS H C-32643
BUBLAY T M B-47821
BUCHLOH G H-47806
BUCHNER R H-18272, H-53376
BUCK M *C-17082, *C-37350, H-21422, *H-24533, *L-81220
BUCKELL M G-15040
BUETTNER W G-28556
BUFF H *F-16218
BUG W *B-55524
BUGAYEV V P C-41064
BULGAKOV M V *H-22930
BULGAKOVA N G A-42731
BURCH D E *C-75058
BURCHARD J K *A-55212
BURGHARDT H H-28483
BURKAT V S *B-37544
BURNS K N H-13213
BURRELL B W A-48116
BURSCHE E *H-39902
BUTCHER J E H-25735
BUTCHER, J E H-04924
BUTTGEREIT CH A-32635
BYCZKOWSKI S *G-52557
BYFORD C S C-30007
BYKHOVSKAYA M S C-46303
BYLER D M *F-81496
BYRNE J L C-26400

C

CADOFF B C C-79003
CALACETO, R R B-06587
CALDWELL J D-58218
CALL R A *G-23763
CALL, R A *G-04849
CALVERT S *B-76008
CALVEZ C *B-32712
CAMPBELL, M W C-07710
CANTE C J *C-44933
CARDUCCI C N C-15355
CARLSON C E *H-45604, *H-51484, *H-52829, *H-52994
CAROTTI A A *A-31529
CARPENTER F G *G-28041
CARR R A D-62438
CARRIKER, R C H-03570
CARROLL R E *A-27595
CARSON J E D-33080
CARSON, T R *G-06288
CASS, J S *H-00600
CASTANEDO A G-36751, G-44867
CATCOTT, E J *G-03394
CATENACCI G G-79980
CAVAGNA G *G-14319, *G-40635
CECCARELLI V H-24035
CECILIONI V A G-15555, G-16874, *G-22628, *G-48697
CECLIONI V A *G-66044
CERWENKA E B-74480
CHAIX P *F-28428
CHAMBERS L A *A-32060
CHAMPAGNE J *J-76213
CHANELES J *G-16047
CHANG C W *H-21498
CHANG, C W *C-03478, *G-01338, *H-01664, *H-03360, *H-06342
CHAPMAN F E JR *B-43481
CHAPMAN R A C-24331
CHAPRON Y *C-21881
CHARI K S B-60282
CHARLES H D-24801
CHASS, R L A-09785
CHAUSSE P G-39813, G-39924, G-39931
CHAUVINEAU A B-521[illegible]
CHEESEMAN E A G-15040
CHEN E C-25441
CHENG, J Y *H-12032
CHEO P C *H-33127
CHERKASSKIY M L B-38874
CHERNYAK L M B-37115
CHERNYSHEV S K F-21632
CHIARENZELLI, R V *I-00695
CHIDA I C-12451
CHINDA M D-77512
CHIYO S H-59327
CHOBOTAREV A N B-41932
CHOLAK J *C-25806
CHOLARK J *D-23845
CHONGPISON B A-80238
CHOVIN P *A-17357, *C-35441
CHRISTIAN W F-22219
CHU C K *F-69599
CHUNG K C *L-44054
CIFERRI R *C-32631
CIOSEK A *C-56244
CISZEK H E-37013, E-37639
CLAYPOOL D W H-45663

CLAYTON, J W JR *G-01426
CLYNE M A A *F-78035
COATES F I B-76232
COCHRAN C N *B-22853, *B-57706
COE R R F-04768
COE, R R C-04687, C-04757, H-04678, H-04679
COHEN I R C-05914
COHRS P *H-18271
COHRS, F *H-11452
COLEMAN C H *H-22789
COLLET G H-28446
COLLIN F C *L-38573
COLLINGS G H JR *G-24126
COLOMBINI M *A-13701, *G-13215
COLPITTS J W B-31567
COLUSSI A J *F-32952
COMEAU G H-36883, *H-48403, H-60690

COMPTON O C H-19124, *H-19358, *H-22084, *H-22085, *H-22092, *H-26718, *H-45663
CONNOR J M *B-54799, *B-69131
CONROY, R J *G-05504
CONSTANCE J D *E-44030
COOK C C B-19487, *B-31567, *B-36755
COOKE N E *A-35985, *E-29315
COOPER H B H JR *C-35956
COOPER R M A-35985
CORLEY J P *L-57270
CORMIS L D *H-23386, *H-24852, *H-27785, *H-28600, *H-51470
CORN M *G-38721
COTE E A E-78793
COUFALIK F *B-18536
COVENTRY D H D-26086
COWLING D W H-60760, H-69800
CRABLE J V C-27294
CRAFTS, A S H-03616
CRALLEY L V *C-23546, *C-23547
CRAMPTON, E W *H-09553
CRANE G B *A-21380
CRASTE, C *A-12548, *G-12547, *G-12549

CRAWFORD V A *F-57580, *F-57581
CRAXFORD, S R *C-03119
CREMER H D G-28556
CREVELING, R K H-04403, H-05667
CRIST H C-69765
CRISTIANI H G-39497, *G-39799, *G-39810, *G-39813, *G-39924, *G-39931, *H-39607, *H-40599
CRISTIANI, H *G-12550, *H-12551, *H-12552, *H-12553
CROCKER B B *B-20857, B-22484, *B-25523
CROCKER T D *H-59935, *J-28805
CROCKER, T D *B-09664
CROCKET D S *C-24022
CRONE J *L-40889
CROSS F L JR *A-13353, *C-46034, *C-51762, *D-71272
CROSS, F L JR *A-12095
CROWLEY D P *A-48116
CSINABY L *L-83965
CSINADY L *A-72079
CUCCHIARA, O *C-04405
CUMPSTON A G *G-23563
CUNNINGHAM P T B-75387
CVRK Z B-38439

D

DAESSLER H G A-53751, *H-31733, *H-37346, *H-38332, *H-41439, *H-47286, *H-64166, *H-66983, *H-69966
DAGAN B N *B-32627
DAINES R H H-12133, *H-14968, H-26717, *H-42958
DAINES, R H *H-01800, H-03873, H-06557
DALY G T *H-76233
DAMON W A *B-24033, *L-39749
DAMS R *A-36045
DANA H J C-22879, C-24399
DANBY N P H-40472
DANCHICK R S *A-74586
DANGERFIELD A D C-27330
DANIS, A L A-00220
DARLEY E F *H-17779, *H-56655
DARLEY, E F H-03612, *H-05342, H-05724
DAVIDS P A-50938, *A-51100, *A-71615, *B-50937, *B-51101, *B-59845, *B-61259, *B-79657
DAVIDSSON I *H-38411
DAVIS D D *H-25769
DAVIS H V G-41036
DAVIS K A *D-30058
DAVIS, F C-04458
DAVIS, R V G-04849
DAVISON A W *D-52811, *H-70607
DAVYDOVA V I *G-66668
DAWE R A F-19175
DAWSON P R B-30519
DE CORMIS L *H-13804
DE CORMIS M L H-28476
DE CORMIS, L *H-02041
DEAN G H-21501, H-60559
DEAN G L *H-17705
DEAN L A B-12127
DEAN, G *H-00240
DEBIARD R *C-28441, *C-28462
DECHIGI M D-23392
DECKER, C E C-10966
DECORMIS L *C-81357
DEE L A *C-73127
DEGRAZIO, R P *C-06352
DELL G J B-54799, B-69131
DEMAIO L *C-40422
DEMETER J J B-33554
DEMIDENKO, N M *G-08201
DEMOLE V *G-11945, G-28556
DERIVAUX, J H-11469
DERNER, H A *F-07714
DERRYBERRY, O M *G-06497
DESBAUME S P H-28446
DESBAUMES E C-40705
DESBAUMES P *C-40705, *H-32897
DESCOI AS J *B-45544
DESCROIX P *A-74154
DETRIE J P *I-54961, *N-64545
DEUTSCH S *C-24359
DEVILLIERS, A J *G-07013, *G-07961
DEVITT T W A-75089
DEVLIN E L H-32736
DEVOLDRE J G-33276
DEWEY J E H-45604, *H-53025
DEYSING G *A-66977
DICKE C M *I-40833
DICKINSON, J *A-09785
DIDIER B *H-28443
DIETZ R N E-78793
DIMITRIEV M T *D-34008
DINH D L *H-47806
DINMAN B D G-23563
DIOURIS M *H-80536
DOBBS C G *A-47061
DOBOS G *B-67954
DOCHINGER L S B-84391, *H-59028
DOLGNER R G-31319
DOLHOVA L H *H-84484
DOMINGO R C C-80495
DONAGHUE, T C-04405
DONALDSON H M *B-28945
DONAUBAUER E *H-32334
DONOVAN J R *B-18826
DORINOVSKAYA A P *G-32596
DORSETT, R S C-04463
DORSEY, J A *C-05317
DORST J *G-74290
DOST F N *G-12403, *H-16617, *H-57859
DOST, F N *G-01096, G-08030
DOTREPPE GRISARD N *A-48231
DOUCE W C *L-43007
DOUGLAS T H J G-15040
DOYEL T E A-50242
DREHER K V *H-36785
DREYHAUPT F J *A-31333, *B-38476
DRINKER P *A-24039, *H-43622
DROBIZ A M C-36125
DROSCHA H *B-65638
DRUETT H A G-15040
DUBROVINA Z V D-17642
DUEKER M H-45467
DUEMMLER F *L-17472
DUGGER, W M JR C-05892
DUKES R R A-18323
DUNCAN L J K-68224
DUNNING J M *G-39833
DURAND G *L-60630
DURST R A *C-20892, *C-20895, *C-31712

DUUREN H V *E-78943
DYBCZYNSKA K *H-38574
DYKTOR H G *D-63526
DZIUBEK T *H-32588

E

EANES E D F-26990
EANES, E D H-04917
EBISAWA E *D-84625
EDDY, L D C-07710
EDMUNDS G F JR *H-56637, *H-56788
EGAN H *C-80103
EGGEBRAATEN V L *C-32966
EGGEBRAATEN, V L *C-07860
EGOROVA T S G-35670
EGUCHI T *C-28102
EGUCHI Y E-49185
EHRLICH, C *H-12554
EICKELPASCH D *B-42172
EISERT W B-48805
EL NICHNYKH L N G-32601, G-32605, G-32606, G-33561
ELFERS, L A *C-10966
ELLERTSON F E H-19124
ELLIOTT S H-45663
ELLISON W *B-27282
ELSHOUT A J E-78943
EMIK L O H-17749
EMIK, L O H-00737
EMLER V S *D-56463
ENDER F *H-32289
ENDO A H-30805
ENGELBRECHT A H P *H-56625
ENGLISH M *B-67136
ENNAN A A B-13771, B-23310, *B-41932, F-15927
EOLYAN S L *C-36771
EPSTEIN B D *C-56681
ERAMYAN S G C-36771
ERDMANN W G-71617
ERGA O *B-13676, *B-18698
ERGA, O *B-10372
ERICSON Y G-28556
ESCOURROU R *A-37996
ESIK V K A-76411
ETTERICH O *A-52912

F

FABIAN R J *I-40510
FABLING F T C-30007
FAITH W L *B-32190
FALTOT G C-21881
FANKHAUSER R D-58218
FARKAS M D *A-18323
FARKAS, L A-07650
FARR T D B-24117, B-24834
FARRAH G H C-68086, *G-26873, G-27755
FARRAH, G H *C-07871
FARRIER P M *B-76232, *H-69162
FATTINGER V *B-83667
FAVINO A *G-79980
FAVORITE F G *K-60887
FEDER W A *H-76452
FEIGE N G *B-73031, *I-63935
FELDSTEIN M C-12760, C-27341, *C-41491, *G-19148
FELICIANO A *H-67026
FELLENBERG T V G-11945
FENSTERSTOCK J C C-12334
FERCHAU, H A H-05585
FERGASON, J L *C-04458
FERGUSON W S *C-44710
FERIANCOVA MASAROVA Z *H-32672
FERRANDO R *H-13159
FERRARI L B-41418
FERRELL J K A-75146, A-76459, A-77993
FERRO, O *H-11456
FIALKOV YU G *B-38874
FICHTEL K *B-82446
FIELD P E *F-14970
FINCH A G-12403
FINKEL SHTEIN, D N *C-10632
FINLAYSON J B A-79567
FIORCA V G-41035
FIRKET, J *G-12555
FIRSOV A G B-41932
FIRST M W B-24110, *B-26745, B-35448
FISCHER F *B-42078
FISCHER G *C-44174, *C-44177, G-12987, G-14477
FISH W M *B-60206
FISHER F G-52764
FISHER J W G-37791
FLACK F C C-17117
FLECK W D-19966
FLEMING R B L G-24126
FLEMING, R B L G-06497
FLETCHER R H *L-20273
FLORENTIN D *G-32607
FLOWER F B *N-66750
FLURY F *G-40597
FOGEL M E J-30696
FOJT W E-44277
FOLKERTS G H-15213
FOSTER L L *G-23711
FOURCY A C-28441, C-28462, H-51271, H-60595, H-62597, H-63167
FOURNIER P *G-30788
FOX E J *C-24114
FRANCIS F J *B-44638
FRANCOIS H C-21881
FRANCON F *G-81250
FRANK W B B-22853
FRANKENFELDT R E *L-46586
FRANZA M E B-77475
FRASCA R L *B-59230
FRASZCZAK K *A-79511
FREDRIKSEN H *J-48171
FRENCH J G *G-73658
FRISCH N W B-46050
FRITSCH P *B-47466
FROMAGEOT C F-28428
FUHRMANN H *C-44238, *C-63848
FUHRMANN N *A-38657
FUJIE K C-12451
FUJIEDA Y H-48356, H-58777
FUJII S *H-52698
FUJINAGA T *C-32534
FUJISAWA G B-14444
FUJIWARA M *K-58899
FUJIWARA T *H-52135
FUJIYOSHI K *A-58370
FUKABORI S *G-50419
FUKUI S *B-16555, *C-28126, *C-32476
FUKUMORI R *B-69191
FUKUZAKI N *A-82269
FULLER W R *B-61954
FUMAROLA G *A-55601
FUMIO T C-38905
FURMAN N H C-39239, C-39243
FURUKAWA A D-50550

G

GAESSLER W *L-48719
GAFAROV M N B-80863
GALLAGHAN, H E III H-11100
GALANTAI P *A-67940
GALBALLY I E *E-79132
GALL D *N-37027
GALLOWAY H L *H-79368
GARBER K D-43170, *H-16150, *H-16152, *H-17822, *H-18265, *H-18266, *H-19873, *H-20917, *H-22624, *H-23661, *H-28477, *H-30301, *H-43492, *H-43493, *H-45007, *H-50677
GARDI R A-55601
GARDNER D E G-25946, G-33505
GARDNER W S *H-68602
GARRAD J G-15040
GARREC J P C-28441, C-28462, *H-51271, *H-60595, *H-62597, *H-63167, *H-83082
GARRIDO J G-84137
GARTRELL F E *A-32139, *B-25038, *B-32232
GASIOROWSKI K *A-46925
GASPARINI G D-21419
GATTI R *F-16370
GATZ D F *D-33080
GAUTIER A *A-40600
GAUTIER R G-39799, G-39810, H-39607
GAUTIER, R G-12550, H-12552, H-12553
GAVRILYUK M V A-63661
GEDALIA I G-28556
GEHRING D G C-23517
GELPERIN N I *B-26317, *B-40414
GEORGALIN R A B-13771, F-15927
GERDES R A *G-30385, *G-30387, *G-37240, *H-51905
GERHARD J *I-69995
GERHARDS K *A-50961, *A-51102, A-71615, B-61259
GERNET YE V C-46303
GERSCHMANN, R *H-12556
GERSTEIN S M *B-77475
GERSTLE R W A-09214, *A-09321, *A-09332, *A-09651, A-09692, A-09693, A-09694, *A-11541, *A-65064, J-30696
GIANG B Y *C-52629
GIARRUSSO, G A C-09770
GIEBEL J A-40471
GIESE H J *K-78880
GIESSLER H H-18270
GIETAZYN T G-52557
GIEVER P M C-27294, *C-50922
GILBERT O L *H-59184, *H-67347, *H-69488, *H-80189
GILBERT T *C-49391, *D-25593, *L-77817, *N-63776, *N-69692
GILCREAS F W *C-28671
GILLETTE D G *J-60298
GIOVANARDI A *D-18537
GISIGER L *H-44428, *H-63442
GIVAUDON J *B-35111, *B-45846
GLAWISCHNIG E H-48167, H-48193, H-65103, H-68770
GLEBOVA L F K-28466
GLOWIAK B *B-71623, *B-78245
GLUSKOTER H J C-64912
GNAGY R M D-23760, H-24566
GNYP A W *A-80238
GODDARD A J H *E-64013
GODZIK S H-41189, *H-49644
GOERGEN R B-40892, *B-43108
GOLDBERG, N N C-04458
GOLDMAN A C-79843
GOLDSMITH J R *G-05833
GOLDSTEIN G *G-43277
GOLDSTON L N D-63526
GOLUB Z H-34880
GOMEYUK A S *C-79835
GONCHAROVA R B B-47821
GOODWIN D R A-21380
GOPALACHARI A S *B-58466
GORDON C C *H-70487, H-80535
GOREL CHIK, K I G-10247
GORYKIN S F F-21632
GOSTOMCZYK A B-71623
GOSTONCZYK B-78245
GOTO M C-58278
GOTSU I *A-52277, *A-58334
GOTTLER H *B-63540
GOTTLIEB K A-56192
GOULD C J H-18704
GOURDON F *C-80573
GRAAF H D *A-25305
GRAEFE K *D-44799
GRAETZ R *B-64428, *B-77816
GRAHAM R R B-12465
GRAHAME D C *F-21389
GRAND CLEMENT A M C-21881
GRATZ R *A-76644
GRAUE, G *B-10618
GRAVES H B JR H-44345
GRAVESS H B JR H-35578
GREEN W H F-46162
GREENBURG L *C-24603, C-27294, N-28923
GREENWOOD D A G-23763, H-04850, H-17620, H-25735
GREENWOOD, D A G-04849, H-01092, H-04919, H-04923, H-04924, H-04925, *H-05004
GREIFER B *A-75077, *C-79003
GRELLAT P G-81250
GRIEFER B *C-75339
GRIER J G C-27933
GRIESER N *G-10842, *G-60748, H-10841, *H-10843
GRIFFIN S W *H-23222
GRIFFITHS J E *G-49223
GRIGGS M C-79842
GRIMBERGEN M V *A-72133
GRIMES W R F-13998
GRJOTHEIM K *A-49886, *A-55407
GROMOV B P B-38874
GROMOV B V B-58632
GRONBACH G H-18270
GROSS U I-63139
GROSS, P G-07013
GROSSERJ *D-31396
GROSSMAN R A C-24022

GROSSO E D-18537
GROTH E III *H-80711
GRUBER G I B-45078, J-39910
GRUENDER H D H-18268, *H-40916, *H-52964, *H-66035
GRUMBACH H H-31733
GRYVNAK D A C-75058
GRZYWACZ A *H-40341
GUARISE G B B-46086
GUBRIC P B-18641
GUDERIAN R H-16222, H-18265, H-22624, *H-30298, *H-38017, *H-68575, *H-69596, H-84290
GUDJONSSON, S V *G-12532
GUENTHER K H H-32516
GUERRANT G O *C-14288
GUILLEMET F B H-16472, H-16896
GUILLEMET, F B H-04403, H-04672, H-05324, H-05667
GULDENMUNDT J P A-64926
GULLY A J *B-12465
GUNTHER, W H *I-08076
GUTHMANN, K *A-01528
GUTSCHE B *C-41020, *C-41063, *C-61859
GWIRTSMAN, J C-04685, C-04686, C-04689, C-04691, C-04692, *C-04757
GYLSETH B *G-84233
GYOERKOES T *H-42946

H

HAAGEN SMIT A J *E-29774
HAAR U D *L-25542
HABEL K *C-30300, *C-55367, *C-67528, *C-76212
HABEL, K *C-11404
HACHMANN H *B-37402
HACKEL R *G-54302
HAENIG G B-28709, *B-40381, *B-40712
HAERTEL O *H-49647
HAFF L V C-23546, C-23547, C-68086
HAGE, K D *E-02325
HAGEN A R *G-24494
HAGEN K O B-52179, C-52206
HAGER J *L-67888
HAGIHARA Y H-42086
HAGIMA I G-49164
HAGIWARA T *C-35737
HAIS K *H-23624
HAJDUK J *H-14678, *H-36996
HAJDUK T *H-26491
HALBWACHS G *H-16092, *H-19949
HALBWACHS, G *H-11650
HALL H J A-59257, *A-73078
HALL R H G-33505, *G-33872
HAMADA, A G-04734
HAMAMOTO H *C-48315, *D-48791
HAMMER D I G-71536
HAMMING, W J A-09785
HAMMOND R *B-22943
HAMMOND, W F *A-09799
HANCOCK J K *F-46162
HANEDA M *C-38905, *H-48291
HANNAN P J D-62438
HANSEN E D *H-24548
HANSON G P *H-26055
HANSON V W C-82650
HARA M A-28652, H-29443, H-29597
HARDIN L J D-24717
HARDING, C I A-00220, *A-03450, *D-09658
HARDISON M A H-24362
HARMSEN H *C-61103
HARNER F H-15501
HARNER F M H-14247, H-21501, H-60559
HAROUTIOUNIAN E *C-32643
HARRINGTON, D E *C-04463
HARRIS L E *H-17620, H-25735
HARRIS P F H-48374
HARRIS R L B-41839
HARRIS R L JR *N-12307
HARRIS W E *C-24018
HARRIS, L E *H-04919, H-04923, H-04924, H-04925, H-05004
HARRISS R C *C-18344
HART G E *H-25618
HARTIG R G *B-31708, *B-40251
HARTKOPF G *A-32519
HASEGAWA T A-31144, B-28783, B-28786, *H-20707, *H-20708, *H-28647, H-42601
HASELHOFF E *H-36742
HASHIMOTO H *L-42810
HASHIMOTO M *L-17188
HASHIZUME T A-52664
HASSOUNA M G H-55066
HASUMI K A-52277, *H-48377
HATA A *A-49617
HATCHARD, R E A-05601
HATTMAN E A A-57231
HATTORI S *B-49420, C-48315, D-48791, G-81181
HATY R *B-60282
HAUGEN, G F-01677
HAUGEN, G R F-03062
HAUT H V C-39762, *F-55415, H-21422, *H-39328, *H-39782, *H-41362
HAVAS P *H-81771
HAWKSWORTH D L *H-78402
HAYAKAWA S H-83723
HAYAKAWA T A-58370
HAYASHI H *B-28783, *B-28786, H-28647
HAYASHI, H G-04734
HAYNIE F H I-69995
HAYSOM H H E-78933
HAZUMI K *A-43816
HEAGLE A S *H-62275
HEANEY R J *D-33858, *D-69144
HEBBEL H H B-64696
HECH W W H-49779
HECK W W H-30473, H-49778
HECKEL E F-69599
HEGGESTAD H E A-71273, *H-45540, *H-45776, *H-46262, *H-49778, H-49779
HEGGESTAD, H E *H-12042
HEICKLEN, J F-02517
HEILINGOETTER R *C-24970
HEIMLER B *A-74262
HEINDRYCKX R A-36045
HELD A J G-11945
HELLER L I C-25210, C-28843
HELLWIG A *A-33735
HELMS G T *D-26086
HEMMING C *B-43840
HEMPEL D A-33735
HENDERICKSON E R C-28671
HENDERSON, J J A-00220
HENDRICKS R H H-17710
HENDRICKSON E R A-22547, *C-27044, C-27294, *C-29771, *D-32679, *E-37037
HENDRICKSON, E R *A-02019, C-11779
HENDRIX J W H-24402
HENRY J L *A-18656
HENRY W M D-52578
HEPTING G H H-17697, *H-46198
HEPTING, G H *H-01398, *H-03676
HERLEM M F-41543
HERMANN P C-29737, *C-38741, *C-39008, *C-55923, *C-77427, *C-78426
HERMANS K H *N-66718
HERRICK R A *A-41877
HERRING F G F-80516
HERRMANN R C-41020, C-41063, C-61859
HERTZOG D *C-22458
HESS T L A-19400
HESTER W D-24717
HETTCHE H O *A-48849
HEUSER S G *C-26203
HICKEY, H R *B-11686
HIGGINS E A *G-41036
HIGH D M A-45858
HIGNETT T P *B-24355
HILDEBRANDT P W *C-39022
HILL A C C-25487, C-28285, *H-16245, *H-16387, *H-26711, *H-31527, H-45009, H-56204, H-71931
HILL E L J-30696
HILL, A C C-04038, C-04540, *H-10673
HILLMAN W S C-68086
HILST, G R E-02325
HINDAWA I J D-26086
HINDAWI I J *H-06395, *H-65394
HINKLEY E D *C-50337
HIRAI T *H-83721
HIRATSUKA N *H-70279
HIRATSUKA T H-71078, *H-77325, *H-77329, *H-82520
HIROSAWA I *D-53889, D-71348, *E-49433
HIROSE H *H-74459
HIROSE I C-84209
HIROTA Y H-71098
HISATSUNE T *B-38115
HISATSUNE, I C F-04674
HISHIDA K A-32855, *A-60421, *B-19212, *B-50868, C-50876, *N-50867, *N-64937
HITCHCOCK A E H-25230, *H-32771, H-46051
HITCHCOCK, A E C-00626, C-00636, C-00941, H-00631, *H-00633, H-00920, H-00964, H-00979, H-01506, *H-04678, *H-04679, H-04732
HLUCHAN E A-17116, D-13838, *D-14066, *H-23579, H-25665, H-32673
HLUCHAN, E A-06241, *D-07579
HOBBES P C-45344
HOBBS, C S H-06353, *H-06354
HODGE H C *G-22551, G-25946, G-28556, *G-61646, *K-17375
HOEKE B *B-17463
HOEKE E *B-47463
HOELSKEN H *A-71477
HOELTE W H-46721
HOERICHT W *H-39190
HOFFER R F D-23845
HOFMANN A W F-16218
HOHMANN E *A-56192
HOLLAND, M *B-07664
HOLLANDER E *A-13242
HOLLINDEN A B *E-33092
HOLLOMAN A JR H-26711
HOLLYWOOD B G-37791
HOLMES R E E-64013
HOLST R W H-13474
HOLUB Z *H-57716
HOMANN K H *F-59528
HOMES J T *B-18830
HOMMA Y G-49271
HONING F W *H-76715
HONMA K G-45683
HONMA Y G-47906
HOOD, D B G-01426
HOOGSTRATTEN B *H-04850
HOOK A W C-23546, C-23547, C-68086

HOPP H H *H-19147
HOPPESCH J P *C-80495
HORI M C-84213
HORIKOSHI T *B-60255
HORITA H *G-43323
HORN K D-31396
HORNTVEDT R *H-38412
HORTON C A C-27331
HORVATH I *H-56963
HORVATH Z *B-71796, *B-83134
HOSCHEK R *G-18809
HOSHINO M C-70638, C-84182
HOSHINO Y *A-46558
HOSOKAWA Y *D-77512
HOSONO Y A-58402, B-58380
HOUGH D C C-82552
HOUTEN J G T *H-24036, *H-45214, *H-46338, *H-54755
HOUTEN J G TEN *H-66714
HOWARD O H *C-26692, *C-26981
HOWLE C W JR C-23654
HSUEH L A-26254
HUBER G L *A-83637
HUBER H *H-41699
HUENLICH H W *B-37603, *B-63775, *B-79079
HUEY N A C-12593
HUFF P B *H-28830
HUFFMAN W T *H-40201
HUFFSTUTLER K K *D-28188
HUFFSTUTLER, K K *A-00340
HUGHES E C *B-22923
HUGHES E E C-79389
HULLETT S H D-56463
HUMPHREYS V *L-47380
HUNTER D G-15040
HUPKA, E *H-12533
HURST R L H-14121
HUSMANN K *B-28709, B-40381, B-40712

HUSSEIN M B-51720
HUTTUNEN S H-81771
HYNES, J A-07650

I

IDA H C-84214
IHIDA M *C-53625, *C-58842
IINO A C-84213
IITOYO S C-84182
IL INSKAYA G I A-42731
IMAGAMI K *C-64779
IMAI M A-58402, B-58380
IMAI S *H-78681
IMHOFF C C-40705
IMURA T B-47125
INAGAKI K *C-74942
IONESCU A *H-66798, *H-74626
ISAACS G A-75089
ISAHAYA F *B-68633
ISHAHAYA F *B-83613
ISHIDA H *K-80854
ISHIGURO T *A-32855
ISHII T C-53625, C-58842
ISHIKAWA H *H-84650
ISHIKAWA S G-68520
ISHIYAMA K *B-52852
ISMAYLOV A R H-23188
ISRAEL G W *C-60278, *C-60410, *E-70747
ITAI K A-82944, *D-69744, G-71324, G-74380, G-81018, *H-70357, H-70745, H-79633, H-79635, H-84579
ITAYA K G-79634
ITO A *C-44552
ITO E C-12451
ITO M D-50550, H-70279, H-77329, H-82520
ITO S B-30814, C-19500, C-21855, C-37463, *C-47096
ITOHARA S A-52277
IVANOV, A E *G-10247
IVERSEN R E *B-43299, B-44838, *B-52838
IVIE J O C-06397, *C-20540, *C-26396, C-39871, *C-53987, *H-18770
IVIE, J O C-01313, C-01349, *C-05892, C-07763, *C-11779, H-06459, H-07255
IVOS J *E-37013, *E-37639
IWAHASHI I A-52277
IWANAGA T *H-74588
IWASAKI M H-74459
IXFELD H C-27962, *C-29426
IZUMI S D-77512

J

JACKSON J JR *B-43863
JACKSON M L *C-44881
JACKSON W A C-24114
JACOB K D *A-44681
JACOBS M B C-24603
JACOBSON J S C-06398, *C-11691, *C-25210, *C-28843, *H-20874, H-32771, H-54710, *H-67304
JACOBSON, J S C-00626, C-00636, *C-00941, C-03503, *C-11041, H-00631, H-00633, H-00920, H-00964, *H-01506, H-02382
JACOT B H-28446
JACQUARD F H-16567
JAFFE J B-38299
JAHR J *C-44083, G-84233
JAMES H A *H-68394
JAMRICH V *H-43663
JANETZKY J E-44277
JANOVICOVA J A-06241, H-25661
JANSEN P *A-47410, *E-59234
JARRAULT P K-68582
JELNITSCHNYCH L N G-37139
JENKINS G N G-28556
JENKINS T F A-49738
JENSEN R M *A-22973
JESENAK V *C-69668
JEWELL J P *B-22484
JEWELL, J P *B-02962
JINNO K G-81181
JOBA, E L I-00695
JOHNSON F B-28889, C-26909, *H-18704, H-26691
JOHNSON L D A-69353, A-79774
JOHNSON, F A *C-08077
JOHNSON, H *H-12045
JOHNSTON J W L-57270
JOHNSTONE H F *A-28038
JOLLY S S G-28556
JONES C M G-43896
JONES L H P *H-60760, *H-69800
JONES T M B-24117
JONES W E F-81069
JONES, C H C-04458
JONKE A A B-18830, B-75387
JORDAN S A-47410, E-59234
JORDAN W VON *B-04794
JOVER, A G-07344
JUERGING P *G-57299
JUNG E *H-32344
JUNGERS R H C-53523
JUST J *A-47954

K

KAAIJK J *C-69526, *C 69675
KAAIJK L *C-59049
KADOTA M C-50093, *H-35964, H-40899, H-50503, H-84545
KAGAWA H A-52277, A-58334
KAHL S *H-61000
KAHLERT E *C-18283
KAHNWALD H B-42172
KAISER E R A-31529
KAJI S D-28771
KAJIKAWA M A-58370
KAJITANI E *B-37809
KAKUNAN T *K-46081
KALFADELIS C D *B-75204
KALIVODOVA E H-32672
KALMON B *A-79043, *A-81916
KAMIYA A D-51929
KAMMHOLZ H *B-74480
KANAMARU G *A-52664
KANAZAWA A C-48315, D-48791
KANEDA K C-21806, C-28530, C-28738, *C-33711, D-66083, G-62177, *H-48556

KANEMATSU S *B-61935, *B-65640, *B-66624
KANGAS J *B-32461
KANTNER A *B-49979
KARBE K *B-22598
KARBE, K *A-12631
KASPAROV A A *C-37799
KASSEBEER G *C-55858
KATARI V *A-75089
KATO K *K-44377
KATO T D-51929
KATS V M B-41932
KATZ M A-08882, C-27294, *C-30840, *C-43672, *C-43979, *C-43981, *C-43985, *C-43986, *D-42760, *H-08884, *L-17614
KAUDY J C *H-20573
KAUFFMANN H *B-44716
KAUROV P I *A-68807
KAUTZ K A-50013, A-52741, A-53295, *A-76638, *A-81343
KAVANAGH D C-24331
KAWABATA R G-81181
KAWAGUCHI T *C-29966
KAWAI K G-45683
KAWAI M *B-47054
KAWAKAMI W A-52277
KAWAMOTO H *L-30620
KAWANO Y A-49617
KAWARADA Y G-56959, H-49434, H-76901
KAWARARYA T *B-60075
KAWASAKI G *A-58402, *B-58380, C-12451
KAWASE Z B-30814, B-48879, *B-53868, C-50470
KAY C E *H-80535
KAY E *H-58507
KAYAMA T *B-53867
KAYDALOV I V B-38775
KAYE S C-41489
KAZAKOVA S B B-37745
KAZANTSEVA E N *H-22496, *H-26978
KE P J *C-57781
KEINITZ H *C-39719
KEITH J R A-68912
KEITZ E L K-68224
KELENFFY S D-32666
KELLER T H-46719, *H-55654, *H-58506, *H-60957, *H-60961, *H-73518
KELLEY J A *B-68201

KELLNER K H *C-68944
KELSO F S *C-23518
KELSO G *A-12587
KEMMER F N *B-47677
KEMNITZ, D A C-05317
KENDRICK, J B JR *H-05724
KENNEDY E D *C-11678
KENNEWEG H *C-56865
KEPLINGER M L *G-21455
KEPLINGER, M L *C-07719, *G-07917, *G-08031
KERBY, G R G-08702
KERIN D *H-35880, *H-50959
KERSTING W B-49979
KERTESZNE M S D-32666
KERTESZNE SARINGER M L-76397
KESSEL MAN P M *F-21632
KESY DABROWSKA I C-56244
KETTNER H *G-71617
KEVENY M H-78956
KHNYGIN V L *A-26329
KHOLIN B G *B-37115
KHUDOLEY I P B-37745
KIELBACK A W *B-16962
KIKUCHI K C-61896, C-68229, H-54066
KILLICK C M *C-34125, C-34126
KIMOTO T *C-20650
KIMURA I *G-56959, *G-74822, H-49434, H-76901, H-79633
KIMURA K C-12451
KIMURA T H-77390, H-77391
KINEBUCHI H G-30183
KING C R B-12127
KING E A-80507
KING W R *A-75146, *A-76459, *A-77993
KIRILCUKOVA V A-06241
KIRILCUKOVA, V G-10203
KIRIY V G C-37799
KIROV N Y *B-80950
KIRSCH H A-50013, A-52741, A-53295, A-61800, A-76638, *A-80994, A-81343
KISHKAREV V A B-80356
KISS I *A-17883
KISSER J H-16092, *H-32343, *H-39466
KISSER, J H-11650
KISTERS T *B-64696, *B-78814
KISTIAKOWSKY G B *F-25636
KITA H *G-61146
KITAGAWA Y *D-50550
KITANO T *B-30814
KIUCHI M B-71412
KIYOKATSU M G-49271
KLEINBERG, S *I-00085
KLEINFELD, M *G-00165
KLEINMAN G B-26674
KLEWSKA A H-61000
KLIMECEK R *B-41378
KLYUSHKIN V P A-42731
KMENT A H-48167, H-48193, H-65103, H-68770
KNABE W A-13615, *H-18507, *H-25099, *H-32516, *H-42954, *H-54297, *H-56885
KNAPP K T C-83442
KNAPP L L *B-19487
KNAUER A D-31396
KNOP W *A-17344, *A-17471
KNOSEL H H-18271
KOBAYASHI G *L-37747
KOBAYASHI H *B-59679
KOBAYASHI M *E-33579
KOBAYASHI Y B-70659, *C-84213
KODOTA M *H-84557
KOEHLER A *D-19966
KOEHLER F A A-79043
KOELLING W B-69528
KOETHE K *B-51755
KOGAI M K *C-61851
KOIZUMI M *A-29532
KOLESNIKOV S A B-37115
KOLESNIKOVA T KH E-29910
KOMLEV A A B-38188
KONDO S B-82032
KONNO N *C-29467, G-56934, G-56959, G-74822, G-74823
KONO H C-48315, D-48791
KONO Y *M-68522
KONOPKA A P *B-46050
KONOVALOV G S *E-29910
KONTRISOVA O H-57716
KOOGLER J B C-60339
KOPP C H-18269, H-18272, H-53376, *H-76297
KOPPE R K C-22879, C-24279, C-24399, D-23760, H-24566
KOPPE, R K C-03550
KOPPEL L B B-18830
KORTE F C-58278
KORTUS J G-14126
KOSHI, K *G-04734
KOSINKSI K C-20595
KOSINSKI K C-20030
KOSTERS J J C-79843
KOSTOLANSKA A *H-32673
KOSTYUCHENKO V A G-52147, G-72083
KOSYUKINA Z T H-84484
KOTLYAREVSKIY P A F-21632
KOTTE W *H-23874
KOVYGIN G F *E-62869
KOWALSKI W *A-84479
KOYAMA D A-28652
KOYAMA M C-32534
KOYAMA T H-29443, H-29597
KOZAKOVA L M B-23310
KOZIMA Y *B-52445
KOZLOV V A *B-26279
KRAFT G *B-38445
KRAMER H P C-23518
KRAUSHAAR J J C-68559
KRECHNIAK J G-52557
KREMER H *A-61154
KREUCH D B-44716
KREY P W *E-77970
KRICHEVSKAYA E L B-13771, F-15927
KRICHEVSKAYA YE L B-23310
KRIJT G D E-78943
KRUEGER E *H-27021
KUBEC Z *C-33632
KUBO K C-12451
KUBO Y C-12451
KUBONO R *C-80935
KUBOTA T *A-61570
KUCZYNSKI, E R *C-03078
KUDRNA J *A-49852
KUEHNERT M *G-50161, *H-25366
KUELSKE S *E-59075
KULUJIAN N *A-09692, *A-09694
KUNIDA H G-38942, G-47906, G-49607, H-49434, H-76901
KUNITA H G-49271, G-76902, H-52096
KUO W L B-47086
KUPCHIK G J C-27294
KURIAN P C *B-81772
KURIBAYA S *H-40899
KURIBAYASHI S H-21194, *H-50163, *H-83145, *H-84089, *H-84541, *H-84545
KURKER, C JR B-07552
KURODA S G-40920, G-47905, G-48636, G-48637, G-49164
KUROKAWA Y G-81181
KUSSY M E C-24546
KUSTOV V V G-68583
KUSUMOTO M C-12451, *C-29220
KUTSYSHIN M A B-47821
KUZ MINA T A *C-46784, C-73471, *C-76030
KVANDE H A-49886, A-55407

L

LAAMANEN, A G-01794, G-07098
LAGARIAS, J S A-02019
LAGOMARSINO R J E-77970
LAHMANN E *D-22348, *D-22359, *D-50690, *D-60574, *D-63186
LAHMANN, E *C-02681, *C-11574
LAIDLAW S I A *G-18987
LAMBERT J L C-26259
LAMBORN, R E G-04849
LANCOUR J B *C-82650, C-84463
LANDBRECHT J C-68944
LANDSBERG H E *E-72995
LARGENT E J C-44596, *G-26461, G-28556, *G-44589, *G-44590, *G-44593, *G-44594, *G-44597, *H-38417, *H-44595, *L-44598
LARGENT, E J *G-04983
LARSEN A A H-32736
LARSON G P *B-25590
LARSON R E D-33017
LATEY N G *B-81773
LAUFHUETTE D W A-76638, A-81343
LAYSSOL, M G-07344
LE TOURNEAU D H-52306
LEBEDEV YU D *K-28466
LEBETSEDER J *H-65103
LEBLANC F *H-36883, H-48403, *H-60690
LECHEMINANT, W H G-04849
LEDBETTER, M C *H-04683
LEDER L B-38082
LEE R E JR C-53523, *C-69765, *D-58218
LEE, C J *H-00788
LEGGETT D C A-49738
LEHMDEN D J V *C-53523
LEIBETSEDER J *H-48167, *H-48193, *H-68770
LEITHE W *C-30014, *H-18319
LEITHE, W *C-06962
LELOCZKY M *G-33766, *G-44362
LEMMENS, A G H-10150
LEMMONS, A I H-02382
LEMOINE R *C-44689
LENC J F B-75387
LEONARD C D *H-35578, *H-44345
LEONARD D C H-37403
LEONARD, C D G-01674
LEONE I H-14968, H-42958
LEONE I A *H-12155, *H-26717
LEONE N C G-25946, G-28556, H-04850
LEONE, I A H-01800, *H-03873, *H-06557
LESOURD D A *J-30696
LESS L N *A-44605, *H-79129
LESTER, D *G-01047
LEVAGGI D A *C-12760, *C-27341, C-41491
LEVIN G M *B-47821
LEVKOV E G A-42731
LEVKOV YE G C-41064
LEVKOVA A S A-42731, C-41064
LEWIS H T JR B-24117
LEWIS J S JR B-37914
LEWIS L L C-24008
LEWIS V A-79567
LEWIS, C E *G-08702
LEZOVIC J *H-13203
LHOSTE A M H-83082
LIANG T *H-67457
LIBERMAN J H-04850

LIBERTI A *C-25223, *C-37579, *C-83495
LIDEN K C-11626
LIEBENOW H *H-35877
LIEBIG G F H-20573, H-27030
LIEGOIS, F *H-11469
LIGEON E H-62597, H-63167
LIHOU D A *B-67846
LIIV R C-45802
LIMANSKII V A A-42731
LIMANSKIY V A C-41064
LINDAU G H-36742
LINDBERG G *B-25195
LINDBERG W *D-33309
LINDBERG Z Y *G-41684
LINDBERG Z YA *G-33509, *G-33510, *G-33511
LINDBERG, Z Y *G-06675
LINDE H W *G-24720
LINZON S N *H-25499, *H-67056
LIPKOVA V G-62596
LISICKY M *H-58381
LIVKE T N A-63661
LIYV R *C-74354
LOBOS J S *B-42458
LOCATI G G-14319
LOCH T A *A-76122
LOCHER F W *A-37752
LOEWA O *L-46561
LOHS K *G-2o274
LOOMIS R C H-76715
LORDS J L H-17970
LORENZ D A-80507
LOUW C W H-56625
LOVELACE C J H-42907
LOVELACE, C J *H-07046, *H-07047
LOVELACE, J *H-02516
LOVELOCK J E *E-29023
LUBORE S H K-69550
LUCAS R C-45344
LUCKAT S *I-52320, I-56143, *I-63871, *I-73616
LUDWIG C B *C-79842, *F-62189
LUDWIG J W *L-24122
LUDWIG T G G-28556
LUESCHER E L-40889
LUIGA P *C-45802, *C-56572
LUIS P *C-15355
LUKEY M E *A-45858
LUNDE K E *B-15813
LUSK W D B-45078, J-39910
LUX H *B-30276, *J-38409
LUXON S G *A-31134
LUXON, S G *A-06371
LUY, P H-12533
LUYGA P C-74354
LYLES G R C-20778

M

MACDONALD H E *A-13699
MACEWEN J D *G-30841, *G-71948, *G-72961
MACINTIRE W H *D-24717, *H-24282, *H-24362, *H-38404
MACLEAN D C H-15213, *H-17109, *H-25273, *H-26916, H-32771, H-34121, H-39986, *H-46051, *H-56240, *H-56515
MACLEAN D I F-59528
MACLEAN, D C H-02382, *H-06404
MACUCH P *D-13838, G-13700, *G-14126
MACUCH, P *A-06241
MADSEN M A H-17620
MAEDA S C-12451
MAEDA T D-50550
MAENO M *H-41904, *H-41983, *H-52102
MAGEE E M *A-59257, A-73078, B-75204
MAHLER E A J *L-39306
MAIEROVA E C-33632
MAIRA S K A-60283
MAISTRUK, P N A-04068
MAJOR J L C-25180
MAKINO S *G-61467
MAKO M H-70279
MALKMUS W F-62189
MALTE P C *E-43855
MALTS V S B-38874
MALTSEVA I M B-32384
MALYSHEVA YE A B-37745
MAMMARELLA L *A-23865, *I-24308
MANABE T H-74459
MANAKIN G A B-13771, B-23310, F-15927
MANCINI J F H-21000, H-56241, H-56521
MANDL R H C-25180, C-74234, H-17109, H-32771, H-46051, H-54710, *H-78956
MANDL, R C-11041
MANDL, R H C-00626, *C-00636, C-03503, H-00964, H-06404
MANGELSON, F L G-04849
MANGOLD C A *G-28139
MANIWA T A-52277
MANKOVSKA B *H-77377
MANNING W J *H-80575
MANTHAPURWAR N S A-60283
MANTLE E C *B-70428
MARCHENKO, E N *A-08486
MARCUJA P A-30517
MARIER J R *A-39587, *G-19055, *G-28037, *G-67325, *N-52010
MARJANOVIC L E-37013
MARJANOVIC L J E-37639
MARSH R K H-45663
MARSH, D *F-02517
MARSHALL B S *C-16801, *C-21730
MARSHALL H L A-44681
MARSLAND A H-70607
MARTENS H H C-73127
MARTIN A E G-28556, *G-39494, *G-43896
MARTIN J F *H-16567
MARTIN, W J *D-01872
MARUYAMA M D-71348, E-49433
MASCINI M C-25223, *C-30793, C-37579
MASEK J H-23624
MASHITA T *B-33971
MASIRONI R *G-36723
MASSEY L M *H-38419
MASSONNE J *B-38593
MASUI T H-74459
MASUI Y H-83723
MASUJIMA H *H-84651
MATERNA J *H-60913
MATHE P *D-37607
MATSUDA N *B-19210
MATSUDA S A-28652, H-29443, H-29597
MATSUI T A-52664, *H-82498, *H-84548
MATSUMARU T *H-79586
MATSUMOTO H B-33918
MATSUMURA T C-12451
MATSUOKA Y *H-58941, *H-64758, H-79586
MATSUSHIMA J *H-33716, *H-52409, *H-54910
MATSUURA A B-36475, D-28771
MATSUURA K G-47906
MATTHEWS J M C-23518
MATTSSON S C-11626
MATZEK N E C-24279
MAURI C A-13701, G-13215
MAVRODINEANU R *F-04768
MAVRODINEANU, R C-04685, *C-04686, *C-04687, *C-04689, *C-04690, *C-04691, *C-04692, C-04757, H-04683, *H-04688
MAY R G-24126
MAYER J D-13838, D-14066, G-14126, H-23579
MAYER, Y D-07579
MAYHEW D J D-23760, H-24566
MAYSTRUK P N A-17076
MAYUMI H H-79972, H-79973, H-79974, H-84048
MAYUMI Y *H-83885
MAZIARKA S C-20030, C-20395
MAZLIAK P *G-80197
MAZUMDAR A H *B-45707
MCBRIDE J J JR H-53370
MCCABE L C *B-24116, *B-24333, *C-24118
MCCALDIN R O *C-22517, *F-52013
MCCALDIN, R O *C-03527
MCCANN C R *B-33554
MCCANN H G *G-26743
MCCARTY C P *C-24886, C-26400
MCCAUSLAND E D H-32736
MCCLAIN R S *B-32963
MCCOLLOCH R C H-20573, H-27030
MCCUNE D C C-06398, H-17109, H-19656, H-20874, *H-21000, *H-25230, H-27006, H-27526, *H-29616, *H-30234, H-32771, *H-38343, H-46051, H-56240, *H-56241, H-56521, *H-65558, *H-76451, *K-13173, *K-26738, *K-67267
MCCUNE, D C C-00626, C-00636, C-00941, C-04691, *H-00631, H-00633, *H-00920, H-00964, *H-00979, H-01506, H-02382, H-06404
MCCUTCHEN G D *K-79255
MCDOWELL C A *F-80516
MCDOWELL L L H-19124
MCFEE D R *G-52638
MCGEER J P B-42458
MCGREGOR A H-79129
MCHENRY C R *D-24801
MCKEE, S B A-03450
MCKENNA F E *C-25615, *C-25616, *C-25617
MCKENZIE D R H-24362
MCLAUGHLIN S B JR *H-78058
MCLEAN W J *C-31827
MCLEOD J *B-41418
MCMACKIN J J A-33853
MCMANUS T *L-80894
MCMULLEN T B C-12334, D-17986, D-24736, D-52575
MCNULTY I B *H-17970, *H-21500, *H-26800
MEADOR M C B-12465, *C-23162
MEADOWS E H JR C-60339
MECKSTROTH E A C-41489
MEGLEN R R C-68559
MEHTA P *B-70840
MEIN W W JR *L-25642
MELLENTHIN W M H-19124, H-19358, H-22084, H-22085, H-22092
MENIN G *B-46086
MENKE K H H-24330
MENZANI, C H-12529
MERRILL M H JR *H-03766
MERRIMAN, G M *H-05421, *H-06353, H-06354
MERZ W H-23214
MESTITZOVA M *K-41266, *K-41267, *K-41295
MICHIYAMA T A-52277

MIDDLETON J T *H-17749, *N-20040
MIDDLETON, J T H-00737, *H-01809, *H-03611, *H-03612, *H-03613, *H-03616, H-05342, H-05724, *K-07605
MIESSNER H *G-67440
MIESSNER, H *G-11467
MIGUERES, J *G-07344
MIKAMI E G-79796, H-74721, H-82146
MILHAUD G H-13159
MILIC D H-32291
MILLECAN A A *J-43002
MILLER C J J-44672, J-67865
MILLER D R *B-75138
MILLER G W C-20701, *C-25441, H-14121, H-15404, H-39363, H-42907, *H-56213, H-62548
MILLER J L C-20778
MILLER K W F-19175
MILLER L E C-32966
MILLER V L B-28889, *C-26909, H-18704, *H-22887, *H-26691
MILLER, G W H-00788, H-02516, *H-04918, H-05398, H-05399, H-07046, H-07047, H-12032
MILLER, L E C-07860
MILLER, R H F-04674
MILLIMAN G E B-75204
MINAKAMI E H-71098
MINAKAMI M *B-36475, B-37164, C-84182
MINER, M L H-01092, H-04923
MINOGUCHI G G-28556
MISIAKIEWICZ Z C-20030, C-20595
MITCHELL D S B-38299
MITRA S K *A-60281
MITSUI T B-38504, B-73175
MITSUKI I A-61564
MIYAI J C-37515
MIYAJIMA K *C-60419
MIYAMOTO A G-61467
MIYAMOTO T H-80083
MIYAZAKI Y *B-50435
MIZOBUCHI T D-50744
MIZUKAMI K B-48879
MIZUKAMI M D-28771
MIZUTANI H *D-5192[illegible]
MIZUTANI M *I-23108
MOACALU T H-74626
MOCHIDA M *H-83182
MOESE J R *G-12987, *G-14477
MOHAMED A H *G-25160, *H-13247, *H-16900, *H-19863, *H-29010
MOHAMED, A H *H-03729, *H-06413, *H-06681
MOHANRAO C J *B-63474
MOLL W *A-47048
MOLYNEUX F *B-17485, *B-21034
MONDEN M *H-32714
MONTERIOLO S C *C-30958, *C-41624
MONTURIOL J M *G-84137
MOOI J *H-46557
MOREAU, G G-07344
MOREY R J A-50242
MORGAN G B *A-23561, *C-12334, D-24736, *L-33495
MORGUNOVA E M *B-80863
MORI M C-21855, C-26952, C-28530, *C-37463, C-37515, *C-73349
MORIK J *D-17102, *D-32666
MORIKAWA M H-79586
MORIKAWA Y C-29467
MORISHITA Y C-12451
MORITA H C-37463, C-73349, C-80935
MOROZOVA, N M C-10632
MORRIS G O *B-67217
MORTENSON, F N *C-01793
MORTZFELDT K A-55407
MOSENDZ S A A-81169
MOSENDZ, S A A-11916
MOSER E *C-29738, *C-64090, H-19539
MOSER, E B-04368
MOTZFELDT K A-49886
MOURA J D *H-52306
MOYER D T C-20540
MRKVA R H-56874
MUELLER L B-51755
MUELLER R F *F-20932
MUELLER U A-56192
MUHLER J C G-28556
MUHLRAD W *B-52172, *B-63784
MUNSHOWER F F *H-65179
MURAKAMI K C-12451
MURAKAMI M H-49434, H-76901
MURANUSHI A B-71472
MURCRAY D G C-79843
MURCRAY F H C-79843
MURRMANN R P A-49738
MYOJO S G-81181

N

NABESHIMA Y G-81181
NAGATA M C-12451
NAGEL, H B-10618
NAKAAKI K G-50419
NAKAGAWA H C-28530
NAKAGAWA Y A-28652, *A-61564, B-37164, *D-28771, *D-49260, *H-29443, *H-29597
NAKAJIMA Y *H-84551, *H-84553
NAKAMORI I H-76838
NAKAMURA A *H-59327
NAKAMURA I G-79619, *G-79623
NAKAMURA J T C-73127
NAKAMURA K *A-31935, *C-74221
NAKAMURA T H-23988
NAKAMURA Y B-52445
NAKAMURA, J T *C-06494
NAKANO M *H-77391
NAKANO W D-36806
NAKAO M A-84542, *H-77390, *H-83258
NAKAO S *C-84209
NAKASHIMA Y *H-42086
NAKAYA S G-68520, *G-71324, *G-74380, *G-79634, G-81018, H-79633, H-79635
NAKAYA T *B-70658
NAKAYAMA M *I-58585
NAKAZAWA A *C-26121
NAKAZAWA Y *D-71348, E-49433
NAOI Y *B-48480
NAOUM M M C-69668
NAPIER D H *G-79848
NARDOZZI M J *C-24008
NARITA K B-28786
NARITA T D-77512
NAROZNY, J *H-12538
NASH T H III *H-67348
NASR T A *H-55066
NASU Y D-58427, D-71362
NAUGHTON J J *A-79567
NAVARA J *H-24787, *H-28409, *H-46923

NAVARA Y *H-34880
NAVRATIL J D *B-122[illegible]
NEDOGIBCHENKO M K K-28466
NELSON K W *A-30447
NELSON L B *B-36405
NERIHAYA F *B-64898
NESTAAS I *C-49476
NETZER W D *B-50652
NEULICHT R M *A-12749
NEURY G H-28446
NEURY J H-32536
NEUSTEIN S A *H-40472
NEWELL G W H-27907, *H-27923
NEWELL, G W H-05612
NEWMAN D J B-54799, B-69131
NEWMAN D W H-21500, H-26800
NEWMAN J R *G-80857
NICHOL A A *C-26400
NICHOLLS J A E-43855
NICHOLS P N R *C-17092
NICHOLS, C W H-05342
NICK, M S G-01426
NIEHAUS F A-48116
NIELSEN H M *C-26744, *C-27927, H-25735
NIELSEN J P *C-27330, H-35613
NIELSEN S W *H-42857
NIELSEN, H M G-04849, H-04919, H-04924, H-05004
NIIDA S B-37809
NIKIFOROVA V Y G-72083
NIKOLAEVSKIY V N *H-27091
NIKOLAYEVSKIY V S *H-36159
NIKOLOYEVSKIY V S H-75027
NISHI Y H-82498, H-84548
NISHIMURA H *G-57701
NIWA T A-58370
NIX T B *B-58993, *B-82918
NOBLE W *H-21364
NOBLE, W M *H-05485
NORO, L G-01794, *G-07098
NOVAKOVA E *G-24392
NOVIKOV A A B-58632
NOVIKOV A I *B-80356
NUCCIOTTI F *C-84471
NUERY C H-24395
NULL H R B-75138
NUNO Y G-81181
NUSBAUM H *C-43234
NYHOLM E B-32461

O

O CONNOR G V *B-44793
O DONNELL, T A C-09560
OBE G *G-54968
OBERHOLTZER J E C-60951
OBERLIN J C H-62597
OCHIAI R A-52277
ODATE Y C-84182
ODEHNAL M B-18536
OELSCHLAEGER W C-18264, *F-14907, *G-47807, H-18270, *H-24330, H-30142, *H-31208, *H-35992, *H-37567, *H-49316, *H-64427
OELSCHLAGER W A-69039, *H-44295
OELSCHLAGER, W *A-02988
OELSHLAEGER W *H-19539
OGAWA I B-36475, B-37164, D-28771
OGAWA S H-42086
OGIHARA T *C-44253
OGIMA I G-40920, G-47905, G-48636, G-48637
OGINO H C-21855, C-37463, C-37515
OGUROK D D C-79835
OHASHI M C-77492
OHKITA T *C-53876
OHMICHI S *C-84214
OHNO C C-50876
OHNO H D-77512
OHNO S *C-50093
OKABE Y C-73349
OKI K G-45683
OKITA T C-12451, *C-21806, *C-26952, *C-28530, *C-28738, *C-37515, *C-40409, *C-48674, *D-66083
OKUMURA E *B-33918
OLIVO R A-13701, G-13215
OLSCHOWY G *N-51942

OLSON A E H-28258, H-49704
OLSON R E *J-32706, J-43547, J-44672
OLSON, L E G-04849, H-05004
ONICHI S *C-19500
ONISHI T G-81181
ONO S H-50503, H-50505
OONO T A-72125
OOTE S B-36475, *B-37164
OPIE W R *B-58879
OPITZ D A-37752
ORDIN L *H-05744
ORDIN, L *G-01728, *H-00654
ORDONEZ B R *G-49756
ORNING A A B-33554
ORTEGA TORRES J *N-49170
OSHINA T G-38106, G-40920, G-47905, G-48636, G-48637, G-49164, *G-62177, *H-58777
OSTERLI V P *H-26092, *H-26158
OSWIN H G C-16109
OTEY M G *B-56064
OTLOWSKI, G J *A-07650
OTT R C-45802, C-74354
OTT, R R *A-05601
OTTAWAY J M *C-82552
OWEN J E B-12127
OYUNG W C-12760
OZAKI K *G-81181
OZOLINS G A-23561, L-33495

P

PACCAGNELLA B *D-23392
PACK M R C-25487, *C-28285, *H-09683, H-16245, H-16387, *H-19657, H-21687, H-26711, *H-27805, *H-31448, *H-81495
PACK, M R *C-00126, *C-04038, *C-04540, *H-02200, *H-08513
PAILHIEZ A B-32712
PAKULAK M S A-50242
PAL D H-37792
PAL G H-66798
PALM C S C-80259
PALM E W *H-25865, *H-65928
PALUCH J *G-51473, *H-33906
PAMPUCH KARSKA, K C-00450
PANEK A F B-75387
PANEL A F B-77838
PANESKO J V *B-47186
PANIN K P *C-32450
PANTELYAT G S B-47821
PANYCHEVA E N G-52147
PAREKH R *B-76512
PARISH W R B-69965
PARSONS R L C-27933
PARSONS W D G-37791
PARTS L *C-69152
PARTSEF D P *B-45380
PAULUS H J *B-36532
PAULUS, A O H-03613, H-05724
PAVLOVIC, R A *H-12540
PEDIGO W R *B-12127
PELL E J *H-70984, *J-55161
PELLA P A *C-79389
PELLISSIER M *H-51109
PENNELL E E C-11678
PENOT M H-80536
PEPE A C-30958, C-41624
PEREGUD YE A *C-46303
PERIN G *D-21419
PERRINE R L *A-26254, *B-26911
PERRY K M A G-15040
PETERS E T *C-60951
PETERSON P J *H-52397
PETINA A A *G-32601, G-45055
PETROVA G D-47982
PETSCHL, G C-06962
PETTIT A B *B-43533
PFAFF R O *A-05139, *A-05140
PFEFFER A *H-41482
PFEFFERLE K H B-42078
PHILLIPPO K A G-16916
PHILLIPS P H *H-26742, *H-38407, *H-67453
PHILLIPS, D *F-02337
PHILLIPS, P H *H-04997
PICCOLI C D-21419
PIKKOV V C-74354
PIKUL R P K-69550
PILAT M J B-25135
PILET P E *G-84236, *H-28427
PIRILA, V *G-01794, G-07098
PISKORNIK Z *H-41189, H-49644
PITAK O *C-57079
PIZARRO A C H-47385
PLAGNAT F *H-39684
PLATT C B-36532
PLOTKO E G G-32605, G-32606, G-33561, G-41685, G-41686, *G-52147, G-72083
POCHASHEV E N G-72083
POCHASHEV Y N G-66668
POKHODNYA I K *A-53955
POLHEMUS J *A-79280
POLLANSCHUETZ J *H-26175
POLLEY D C-26909
POLYKOVSKAYA N A G-32605, G-32606
POLYKOVSKAYA, N A C-10632
POOVAIAH B W *H-16894, *H-22499, *H-64588
POPELKOVSKAYA M V C-51551
POPESCU C *N-14783
POPPE, W H C-07710
PORTEOUS A *A-34334
PORTER, C A C-04691
PORTS K N A-19400
POSNER A S *F-26990
POSTHUMUS A C E-76047
POULOS, N A *C-06983
POWELL W A *C-24124
PRAGER M J C-18696
PREDIKANT H H *B-37509, *B-53620, *B-54310
PRESCHER K E D-22348
PREUSS P W *H-59198
PREUSS, P H-02382
PREUSS, P W *H-10150
PRICE S J W A-80238
PRINDLE, R A *A-00375
PRINZ B *C-25474, *C-72017, *H-84290
PRIVAL M J *G-52764
PROZOROVSKAYA I V B-45380
PRYMAK A V C-65118
PSENAK M H-56213, H-62548
PUBLIC HEALTH SERVICE *D-09590, *L-09677
PUHR WESTERHEIDE H *B-67700
PULLEN D R H-69162
PULLEY H *B-41839, B-56064
PULSIFER H C G-16916
PURVANCE W T *B-23182
PUSHKIN I A C-36125
PUSTINGER J V C-69152

Q

QUARLES J *B-56057, *K-66860, *K-66916
QUELLMALZ E *D-25093, *H-29736, *H-30142
QUINCHE J P H-28446, H-32539, *H-33606
QUINCHE P H-32536

R

RAAY A V *H-32280
RABOVSKII, G V C-02565, C-04105
RADCZEWSKI O E *C-17098
RADELOFF H C-18230, C-33929, *H-18226, H-23639, *H-24024
RADKE D *B-70537
RALEIGH R J H-17620
RALEIGH, R J H-04919
RAMAN V *A-60283
RAMKUMAR G A-60283
RAMM V M B-32384
RAND A W D-52811
RAND W E H-27907, *H-28031, H-28035
RANFFT K *C-60010
RANFT H H-48798, H-64166, H-69966
RAO D N H-36883, *H-37792, H-60690
RAPKO A *B-18641
RASCH R *A-50381, *B-74483
RASTAS J B-32461
RATCLIFFE D B *C-30007
RAWLINGS G D *B-84418
REARDON J E F-62189
RECHENBERG W *C-46443
RECKNER L R C-66753
REED D J G-12403, H-16617, H-57859
REED, D J G-01096, *G-08030
REGIER L W C-57781
REH L B-48814, B-64506, B-81595
REHN K H H-64166, H-69966
REICHERT J G-54302
REIDT M J I-40833
REIMER H *A-37562, *B-56078
REIN J E C-24546
REINERT R A *H-79338
REINHARD H *H-23580
REISSMANN H *B-81256
REITER N F *B-42591
REITHER K *B-66592
REMMERT L F H-19124, H-19358, H-22084, H-22085, H-22092, H-26718
RENZANIGO F *D-40896
REPENKOVA T G B-58632
REPORT OF A SURVEY ON ENV *D-31371
RESCH W C-28374, C-29887
RESHETNIKOVA L Y F-68048
REUSMANN G *C-21156, C-37350, *H-50729
REX, R C-04405
REYBROUCK G A-72133
REYNOLDS D S A-44681
REYNOLDS J M A-08116, A-12749
REZEK A E-37013, E-37639
RHOADS A F *H-80493
RHODES D W *B-55180
RICCA, P M *A-00640
RICHARDS B L *H-27303, H-33468
RICHARDS, B L C-05892
RICHARDSON J D G-15040
RICHEY E P D-23760
RICHTER F *B-45004
RINCKHOFF J B *B-69965
RIPPEL A A-17116, G-13700, G-14112, G-19880, *H-20872, *H-25661, *H-37480, *H-39159
RISTINEN R A C-68559
RISTO A *D-78442
RITCHER P O H-19124
ROARK O F H-15213
ROBAK H *H-32286, *H-52705
ROBBINS M L *H-72762
ROBBINS, W R H-03873
ROBINSON E C-24886, *C-28251
ROBINSON J M *B-45078, *J-39910
ROBINSON, F R *G-11000
ROBSON C D D-26086

RODE W C-77427
RODIN V I B-58632
ROE J W *A-27930
ROENICKE G *D-29040
ROHMEDER E *H-18267, *H-23214, *H-24064, *H-28802
ROHOLM K *G-39219
ROM J J *A-08116
RONZANI E *G-57024
ROOK J F A-21380
ROOT R E G-33505
ROOTH R *B-52179, *C-52206
ROSANO H L C-44933
ROSE D G-28037, G-67325
ROSE W I A-49738
ROSE W I JR A-43403
ROSE, G *A-08816
ROSENBERGER G *H-18268
ROSENZWEIG K A *G-28019
ROSLINSKI L M K-60887
ROSS C W *H-14121
ROSS R D *B-49929
ROSS R W A-13353
ROSS W D C-69152
ROSS W K *B-49031
ROSS, J M *C-00260, C-00264, H-00187, H-00265, H-00266
ROSS, R W A-12095
ROSSANO A T JR *B-25135, C-35956
ROTHMAN, S C *A-01687
ROULET M H-28474
ROUTSCHKA G *A-39635
ROUX M C-45344
ROUZAUD J F H-29991, H-46997
ROWDEN E *A-17377
ROWLEY R J *C-27933, *G-27755
RUCH J B *B-33191
RUDINSKY J A H-19124
RUDOLPH H C-38278, *C-68559
RUEDIGER K C-41063
RUIZ SALAZAR A *G-44867
RUIZ ZUBERO J G-84137
RUSH D *B-44838
RUSH, R S C-04458
RUSHTON W E *B-26674
RUSSELL J C B-44838
RUSSELL W E *B-27839
RYABOV E A C-79835
RYAGUZOV V N *B-38775
RYAN J R A-74586
RYAN K B-13676
RYAN, K B-10372
RYAZANOV V A *K-41682
RYDER E J *H-45533
RYDER R J *A-33853
RYOMI H D-50550

S

SA A C-15355
SABO O B-18641
SADILOVA M S G-12282, *G-32605, *G-32606, *G-33561, *G-35670, *G-41224, *G-41685, *G-41686, *G-41687, *G-41688, *G-45055, *G-72083
SADILOVA, M C *G-10333
SADILOWA M S *G-37139
SAFONOV V N *A-42731
SAID A H H-48167, H-48193, H-65103, H-68770
SAIJO T A-81745
SAITO K *A-81745, *D-50744, H-77390, H-77391
SAKABE H *G-45683
SAKABE, H G-04734
SAKAI K *C-48492
SAKAI T C-77492
SAKAUCHI M C-20650
SAKURAI S D-58339, D-69744, G-49607, G-56959, *G-68520, G-71324, G-74380, G-74822, G-76902, G-79634, G-81018, G-84531, H-65715, H-70357, *H-70745, H-79633, *H-79635, *H-80064, *H-84579
SAKURAI T B-47125
SALAZAR A R *G-36751
SALLADAY D G B-81944
SALTZMAN B E *C-17128, *C-26707, C-27294
SALTZMAN R L C-68086
SALYAMON G S *C-51551
SANDERSON D P B-42458
SANDERSON R T *F-13565
SANTAMARIA P A H-47385
SANTAMOUR F S JR H-45540
SANTY M J B-45078, J-39910
SARACENO A J B-42991
SARMA P L *C-24050
SASAKI K G-38942, G-49607, G-76902, H-49434, H-76901
SATO A D-36806
SATO F A-52277
SATO H G-62177
SATO K *C-70638, *C-84182, G-38106, G-40920
SATO Y G-56934, G-56959, *G-64484, G-74822, *G-74823, G-79796, H-49434, *H-49573, H-74721, H-76901, H-79633, H-82146
SAUDA A G-45683
SAVILLE J M H-32736
SAWICKI E *C-67116
SAWYER B J-76213
SAWYER R F C-31827
SAYLOR J H C-24124
SCAIOLA G *L-25427
SCALA, L C C-04458
SCHACKMANN H *B-48811
SCHAEFER K *C-38280
SCHAEFFER J B-37509, B-54310
SCHAETZLE P *D-73286
SCHAFER L J D-23845
SCHAFFNER, F G-11000
SCHALENKOWA I H-33906
SCHEDLING J A *D-28097
SCHELLMAN B *G-80078
SCHELTEMA H B-41418
SCHIFF H F C-46034, C-51762
SCHIKARSKI W A-47410, E-59234
SCHLEICHER A R J-30696
SCHLERKA G H-48167, H-48193, H-65103, H-68770
SCHLESINGER E R G-28556
SCHLIPKOETER H W *G-31319
SCHMID H G-11945
SCHMID O *B-42104
SCHMID W E H-13474
SCHMIDT A *B-47095
SCHMIDT E A-34096, *A-36212, *A-61183, *B-44121, *B-55678, *B-56591
SCHMIDT H J *H-27907, H-27923, H-28031, *H-28035
SCHMITT C R *A-48572
SCHMITT H *B-18699
SCHMITT N *H-32736
SCHMITT, H *B-04368
SCHMITZ DUMONT W *H-39932
SCHNEIDER D C H-25273
SCHNEIDER E J C-23546, C-23547, C-68086
SCHNEIDER R E H-15213, H-25273, H-26916, *H-34121, *H-39986, H-56240, H-56515
SCHNEIDER T *E-76047
SCHNEIDER W *A-52508, *A-54622, C-18283, *C-27130
SCHNEIDER, W *C-11915, *D-10619, *H-04816
SCHNETZER H L *H-40460
SCHOECK V E *B-55046
SCHOEFFMANN, E C-11915
SCHOENBECH H *H-46721
SCHOENBECK H *H-20476, *H-21422
SCHOENBORN A H-18267
SCHOENBORN A V H-23214
SCHOENMAKER O D *A-64926
SCHOFFMANN E C-27130
SCHOLL G C-38278, H-21422, *H-30297, *H-36994, *H-59947, *H-67480
SCHONBORN A V H-24064, H-28802
SCHORN G *G-55517
SCHREIBER M *J-29923
SCHRENK H H *G-18785
SCHUCHT F *H-45467
SCHUENEMAN, J J A-03450
SCHULTE H J *K-60180
SCHULTHEIS W B-69528
SCHULTZ H *A-57231
SCHULZE E *A-51137
SCHUMACHER H J F-16370, F-32952
SCHUMACHER R L-40889
SCHUURSMA M J N *A-28282
SCHWAGER H H-46719
SCHWARTZ W *B-48805
SCHWARZ K *A-29519
SCHWEGMANN J C *B-38082
SCHWENDIMAN L C L-57270
SCOTT J K G-33276, G-33505, G-33872
SEARL T D B-75204
SEEBACH, H M A-09541
SEIDMAN, G *H-02537
SEKI T D-77512
SEKIUCHI T *C-61896, *C-68229, *H-54066
SELIANKINA, K I G-10333
SELIGMAN R *F-39861
SELYANKINA K P G-33561, G-41224
SEMENOV A N B-80863
SEMRAU K T *A-05811, *A-05871
SENIN V N B-58632
SENKOWSKI B Z *C-24310
SERBANESCU G H-66798
SERPER A *C-29198
SERTZ H *H-39887
SERVUS S B-38439
SETO Y H-74459
SETTE N *H-39627
SHACKLETTE H T *A-68912
SHAFER E G E C-24310
SHAFFER J H *F-13998, F-14970
SHAMSUDINOVA R A A-26329
SHAPIRO J L *B-47086, *F-44721
SHARMA R P H-28258
SHAW C G H-24566
SHAW W C *H-49779
SHAYDUROV V O C-79835
SHCHEKATOLINA S A F-21632
SHCHERBAN O N *C-65118
SHCHERBOV D P C-27131
SHEEHY, J P *A-00220
SHEPPARD, S V *B-08344
SHERWIN K A *B-36716
SHIBUTA N H-58777
SHIDELER M E C-25952
SHIEH J H-62548
SHIGEMORI N E-49185
SHIKENJO N S *H-21189
SHIMA H A-52664
SHIMADA K C-84175
SHIMANUKI K A-52277, A-58334
SHIMANUKI M *L-82278

SHIMIZU K C-12451
SHIMODA M *A-72125
SHIMOHARA K E-49185
SHIMOI Y *B-71412
SHIMOKAWA S A-74512
SHINMURA G *L-35795
SHINOHARA H *H-76838
SHINOHARA K G-30183
SHINOZAKI M H-70279, *H-71078
SHIOI H G-56959, G-74822, H-49434, H-76901, H-79633
SHIPLEY J W *A-39862
SHIRAISHI K G-81181
SHIRASAWA T *B-48879, *B-53875, *C-49509, *C-50470, *C-50876
SHOAF R E H-79368
SHOLTES R S *A-31581, *C-60339
SHRIVER D F F-81496
SHTURKINA O K G-41224
SHTURKINA, O K G-10333
SHUGAEV V A *G-59073
SHUPE J L G-23763, H-04850, *H-13985, H-17620, *H-20690, *H-24944, *H-25735, *H-26734, *H-28258, *H-49704
SHUPE J L G H-25945
SHUPE, J L G-04849, *H-01092, *H-04848, H-04917, H-04918, H-04919, *H-04923, *H-04924, H-04925, H-05004
SHUVALOVA T N F-68048
SHVACHKO V I A-53955
SIDDIQUI A H G-28556
SIEGEL M R B-24355
SIETH J *B-50154, *C-23575
SIEVERS R E C-69152
SIKES J H C-24456
SILAKOVA, A T *A-11916
SILER, R K *E-05054
SILVERMAN L B-24110, B-35448, *C-25952, C-39288
SILVERMAN, H P C-09770
SILVERMAN, L *B-05567, B-07552
SIMON, H A-09799
SIMONINI G C-84471
SIMONSSON L *H-32982
SINGER L G-28556
SINGER, L *G-09575
SINGH A G-28556
SINGH DEV R A-50013, *A-53295
SINGH R *A-52741
SINGLETON, A H I-00085
SKAGGS C H H-79368
SKALICKY M H-48167, H-48193, H-65103, H-68770
SKOE B P H-05744
SKOLNIK E G *F-81069
SKVORTSOV A N B-80356
SLACIK ERBEN R G-54968
SLAGSVOLD L *H-39895
SLEPPY W C B-22853
SLYUSAREVA L I F-68048
SMALLWOOD H N-63463
SMIDT H *A-77367
SMITH C V JR *L-66700
SMITH E B F-19175
SMITH F A G-25946, G-28556, G-33276, G-33505, G-33872, G-61646, K-17375
SMITH J D G-30385, G-30387
SMITH J S J-67865
SMITH M F C-26209
SMITH M L H-70752
SMITH P V *B-36552
SMITH R I *A-15452
SMITH W *C-84499
SMITH W H *B-84391
SMITH, J D H-03729, H-06681
SMITH, L K *D-06809
SMITH, R P G-04927
SMITHSON G R JR B-19177
SMYTH C P F-18427
SNYDER A D C-69152
SOBOCKY E *H-21062
SODERBERG B A F-21389
SOLBERG R A *H-22284
SOLBERG, R A *H-05585
SOLINSKI P *H-84477
SOLNTSEV S S *A-23022
SONE H C-61896, H-54066
SONE M C-68229
SORDELLI, D *A-01125
SOUTHERLAND J H D-26086
SPARWALD V *B-36528
SPECHT, R C *B-06587
SPENCER E F JR *B-47680
SPENCER G R *H-20015, H-26718
SPENCER J D *A-22875
SPICER C W JR *F-53153
SPIEGL C J G-33505
SPIERINGS F *H-17449, H-24036, *H-28480
SPIERINGS F H *H-30299
SPIERINGS F H F G *H-17163, *H-32282
SPINDLER D C *C-26209
SPINKA J *H-47014
SPRUIELL S *A-09690
SPRUNG S A-37752
SPRUNG, S *A-09541
ST CYR L A *B-81645
ST PIERRE C C A-80238
STALBERG S B-76008
STAMATOVIC S *H-32291
STANGE H B-30276
STANKOVA N V F-68048
STARK N B *H-48374
STARNES, W E A-00340
STAS M E *H-33290, *H-39923
STEADMAN L T G-33505, G-33872
STEEL J *A-27314
STEELMAN C JR *I-39031
STEENBERGEN P E-76047
STEFAN K *H-41370
STEIN G *H-16673
STEINDLER, M J I-08076
STEINEGGER S *G-37282, G-56538
STEINEKE F *B-71297
STERN A C *C-27294, *K-47672, *N-28923
STERNER, C J I-00085
STICKINGS B J F-19175
STICKNEY W A B-32963, B-43972
STOCKHAM J D *A-27617
STODDARD, G E H-04919, *H-04925, H-05004
STOIBER R E *A-43403, *A-49738
STOKINGER H E G-27379, *G-28199, *G-28429, *G-33276, *G-33505, G-33872, *K-58638
STOKINGER, H E *H-04544
STONE E C H-20015
STONE E H F *B-49023
STONE R *N-63463
STOOKEY G K G-28556
STRATMANN H C-17082, H-16222, H-18265, H-22624, H-38017
STRAUSS W *B-29403
STRAUTHER J D C-23546, C-23547, C-68086
STRIS J *B-26401
STRONG F C *H-27324
STROUD C A G-33505, G-33872
STRUNZ W *A-31315
STRUSINSKI A C-20030, C-52101
STRUSINSKY A C-20595
STUBER P J B-18826
STUEWE A H *A-24370
SUBBOTINA O P B-80863
SUBIDO P S *H-47385
SUDA B *H-79633
SUDA S G-74822
SUDA T G-56959
SUEDA S *E-49185
SUGAI R A-82269, C-28530, C-28738, D-66083, G-38106, G-40920, G-62177, H-48556, H-58777, *H-82208
SUGANO S *C-50936
SUGAOI R C-21806
SUGENO Y H-83723
SUGIMOTO E *H-84558
SUKEDA Y *G-79796, *H-74722
SUKETA Y A-74512, *H-30805, H-30806, *H-31124, H-74721, *H-79309, H-80085, H-82146, *H-83723
SULLIVAN G V B-32963
SULLIVAN J L *A-20134
SULZBACH C W H-20400, H-81495
SUNAHARA H *C-58278
SUPRUN S A A-53955
SUSLOVA V V *H-73027
SUTHERLAND F H H-16472, H-16896
SUTHERLAND, F H H-04403, H-04672, H-05324, H-05667
SUTTER E *A-50018, *C-30432
SUTTIE J W *H-10711, H-26742
SUTTIE, J W *H-00944
SUVOROVA, S N *C-02565, *C-04105
SUZUKI F C-84182
SUZUKI M A-52277, C-44552, C-50093
SUZUKI N B-73175
SUZUKI T B-38504, *G-52029
SUZUKI Y G-68520, G-71324, G-74380, G-79634, *G-81018, *G-84531, H-79633

SVOBODA K *C-27962
SWANY G R B-31567, B-36755
SWIEBODA M *H-46217, *L-41455
SWIFT W M B-75387, *B-77838
SWITALA E D C-84463
SYRDAL A B-13676
SYRDAL, A K B-10372
SZALONEK I G-51473, *H-32339

T

TABASARAN O *B-79711
TADA G G-50419
TADA, O *C-06112
TAGA T *A-36377
TAIDO M C-44552
TAIRAFUNE K *D-36806
TAIT J C F-80516
TAJIMA Y *G-30183
TAKADA K H-29597
TAKADA N *A-28652, H-29443
TAKADA T A-61564
TAKAGI S H-74459
TAKAHASHI A B-14444
TAKAHASHI M B-28783, B-70658, D-36806, H-28647
TAKAHASHI N *A-40182
TAKAHASHI R *D-77485, *H-30806
TAKASAKI T H-58941
TAKATA K D-49260
TAKEDA Y B-71412
TAKEHARA H *H-16385
TAKESHITA K H-76838
TAKEUCHI J *C-12451
TAKIZAWA J *H-70776
TAKIZAWA Y G-38106, *G-40920, *G-47905, *G-48636, *G-48637, *G-49164, *G-50371, *G-56933, *G-79619, G-79623
TALVITIE N A *G-27753

TAMAKI T *H-28149
TANABE T A-49617
TANAKA A H-32714, H-84557
TANAKA F *A-84542, H-83258
TANAKA Y *H-10342
TANIGUCHI N *C-59814
TANIYA M G-81181
TANIYAMA T *H-61410
TANIZAWA Y *G-83798
TANJI S A-52277
TAODA H *H-61834
TARASOV V M B-26317, B-40414
TARAT E YA B-37544
TARBUTTON G *B-24117
TATERA B S A-31581
TATSUMI T *B-64977
TATSUTANI B *B-71472
TAUDA F *A-26136
TAVES D R G-28556
TAYLOR J K A-75077, C-75339, C-79003, C-79389
TAYLOR O C H-17749, H-27303, H-33465, *H-63626
TAYLOR, O C B-04853, C-05892, H-00737, H-03616, H-07255, H-11407
TEARLE K A *B-35513
TEATS F G B-75387
TEBBENS B D *D-33425
TELLER A J B-22040, *B-29114, *B-45757, *B-53603, *B-61273, *B-64070, *C-60553
TELLER, A J *A-05090
TEMPESTA F L A-48116
TEMPLE P J H-65558
TEN HOUTEN J G *H-28437
TENDRON, G *H-03116
TEPPER L B *C-61957
TERAI K D-58427, D-71362
TERATANI T B-28786
TERJESEN S G B-18698
TERRACCIANO L *A-11876
TESCH J W A-25305
TESINK J *H-66715
TESKE W *A-49924, *B-15322
TEWORTE W *A-30296, *B-21795, *B-33620
TEWORTE W M *B-25178
THALENHORST W *H-72132
THIEBAULT A F-41543
THOMAS A A G-41036
THOMAS D A-79567
THOMAS J JR *C-64912
THOMAS M D C-18016, *C-24966, C-26396, C-28285, *C-39871, *H-16244, *H-17710, *H-28888
THOMAS S H *C-84463
THOMAS, M D C-01313, C-05892, *E-04987, *H-00301, *H-03395, H-06459, H-07255
THOMPSON C R C-23546, C-23547, C-26396, *C-68086, H-18770, *H-21093, *H-33468
THOMPSON Q E B-75138
THOMPSON R J *D-24736
THOMPSON, C R B-04853, C-01313, *C-01349, C-03478, C-05892, *C-07763, G-01338, H-01664, *H-02379, H-03360, H-06342, *H-06459, *H-07255, *H-11407
THOMSON J A L F-62189
THORNE W H-24548
THRESHOW M *H-21501
TICHATSCHKE J *A-30218
TICHY H B-42172
TIMBERLAKE, R C *B-07190
TIUNOV L A *G-68583
TODD, G W *H-03629
TOHI K H-77325, H-77329, H-82520
TOKERUD A C-52206
TOLGYESSY J C-69668
TOMANY J P *B-37080
TOMATSURI M *H-38754
TOMINAGA Y *H-80083
TOMPKINS F C F-57580, F-57581
TOMPKINS, J F JR I-00085
TOMSON N M *B-27569, *D-17642
TORII K *C-36002
TOURANGEAU P C H-80535
TOURNUT J H-29991, H-46997
TOWNSEND L W F-78035
TOWNSEND, C R *C-09770
TOYAMA T C-12451, C-29220
TOYODA F M-68522
TOYOTA H G-81181
TRACHTENBERG, E G-11000
TRANSTRUM L G C-28285, H-16245, H-26711
TRANSTRUM, L G C-01793, H-04904
TRAUTWEIN K *H-18269, *H-18272, *H-53376
TREFOIS M A *A-60827
TREMEARNE T H A-44681
TRESHOW M H-14247, *H-15501, *H-21687, *H-38568, *H-51321, *H-60559
TRESHOW, M *H-00137, H-00240, *H-01250, *H-04904
TRICOIRE, J G-07344
TRIPLER A B JR *B-19177
TROTT P E C-34126
TRUHAUT R *A-70727, *G-34398, *G-34861, *G-41706, *G-46085
TSCHANNEN W H-28474
TSUCHIHIRA K *C-41763
TSUDA M M-68522
TSUDA S *C-41719
TSUGAWA H *B-47256
TSUJI Y G-28754, *G-47906, *G-49271, *G-50414, *G-60228, *G-74821, H-49573
TSUJIMURA S *B-14444
TSUKAMOTO H *C-77492
TSUKAMOTO Y *B-82032
TSUNODA F A-17405, *C-40138, *D-58339, *D-61140, D-69744, *G-23003, *G-26846, *G-38942, *G-40527, *G-49607, G-64484, G-68520, G-71324, G-74380, G-74823, *G-76902, G-79634, G-81018, *G-83177, *G-84266, G-84531, H-48291, *H-49434, *H-52096, *H-65715, H-70357, H-70745, *H-76901, H-79633, H-79635, H-84579
TSUNODA H A-53874, *G-19215, G-28754, *G-56931, G-56934, G-56959, *G-74580, G-74822
TSURENKO M T B-37544
TSURITANI T *B-62165
TUERKOELMEZ S *B-14692
TUFTS B J *C-23657
TUMA J *G-10362
TUMANOV O A C-79835
TURK A *N-44066
TURK D N-44066
TYURIN N A B-26279

U

UBL, Z *C-09983
UDAGAWA M C-12451
UDAGAWA O H-58941
UEDA K *G-71484
UEHARA M H-28149
UMEDA Y H-28149
URSU P G-38616
USSAR M *B-29725
USSAR M B *A-48946, *B-41569
USTINOV V G A-53955
UTVIK A O B-18698

V

VACCARI J A I-40510
VAILLANT G *B-20436
VALACH R *D-23862
VALDBERG A YU B-26317
VALENTINE J R C-60951
VAN ALLEN J C-79843
VAN BRACKLE R D *H-20157
VAN CAUWENBERGHE K A-36045
VAN DE VOORDE H A-72133
VAN DE WIEL H J E-76047
VAN EGMOND N D E-76047
VAN HAUT H H-16222, H-38017
VAN HOOK C *H-81288
VAN LEEUWEN M E-76047
VAN LEUKEN P H-56241, H-56521
VAN STRAATEN J E-76047
VANSELOW A P H-20573, H-27030
VARADI V G-78873
VARGA G M A-73078
VARGA G M JR A-59257
VARKONYI T *L-76397
VARLAMOV M L *B-13771, *B-23310, *F-15927
VASILOFF G N *H-70752
VAUBERT B G-49448
VEDERNIKOV V B B-80863
VELU H *H-26795
VENKATESWARLU P G-28556
VERNOT E H G-30841, G-71948, G-72961
VERTES M A *C-16109
VETTER H *H-61496
VEYSEY S W F-81069
VIEL G H-13804
VIEL M G *H-28476
VILLIERS A J D *G-37791
VINS B *H-56874
VISHNEVSKIY V L G-32596, G-35670, *G-36411
VITALIANO D B *A-32576
VITTORI O *C-23096
VIVOLI G A-13701, G-13215
VOGEL G J *B-75387, B-77838
VOGL J *A-69309
VOISIN C *G-43636
VOL BERG N S *C-73471
VOL BERG N SH C-46784
VOLBERG N SH C-48392
VOLDAYEVA I I A-63661
VOLFKOVICH S I *B-37745
VOROB EV, A M C-02565, C-04105
VORONIN E M B-37544
VOROSHILIN S I G-72083
VOVK T V B-37745
VOYTOV V T *D-37823
VOYTSEKHOVSKIY V G B-37745
VUKSANOVIC P *L-78484
VYAKHIREV D A *F-68048

W

WACLAWIK J *C-27769
WADDINGTON J A-44605
WADE M A *C-23569, C-24456
WADE, R H C-00260, *C-00264, H-00265, H-00266
WADE, R W H-00187
WAGMAN J C-83442
WAITE D A L-57270
WAKI K *B-38504, *B-44343

WALDBOTT G L A-69039, *D-37473, *G-15555, *G-16874, *G-22629, *G-25469, *G-56538
WALKER G B-52179
WALLACE A G-71933
WALLACE A S *G-18988
WALLAR M A *C-12593
WALLIS W J *H-62548
WALSH C G-37791
WALTHALL J H *B-64092
WANDER I W *H-28899, *H-53370
WANDS R C K-60887
WANG C H G-12403, H-16617, H-57859
WANG, C H G-01096, G-08030
WARBURG O *F-22219
WARITZ, R S G-01426
WARNER T B *C-51599
WARREN R P B-26745
WASZAK S C-27769
WATANABE H A-52277
WATANABE I G-47906, G-49271
WATANABE J *H-64824
WATANABE K G-81181
WATANABE T D-77485
WATANABE Y G-40920, G-48636, G-48637, G-49164
WATERS W E H-37403
WATSON G M F-13998
WAYNE L G E-29774
WEATHERELL J C G-28356
WEAVER N K *K-14772
WEBER C W C-26692, C-26981
WEBER J B-71796
WEBER, E *A-00896
WEBSTER C C *H-19604
WEBSTER S H *A-18449
WECKESSER E B-64506, B-81995
WEHRLE P F *G-71536
WEI L *H-39363
WEIDENSAUL T C *H-73510
WEIDMANN S M G-28556
WEIGAND W *G-30145
WEIGLE J L H-72762
WEINECK H *B-40892
WEINSTEIN L H C-23546, C-23547, C-25180, C-68086, *C-74234, H-17109, *H-19656, H-21000, H-26916, *H-27006, *H-27526, H-29616, H-30234, H-32771, H-46051, *H-54710, H-56241, *H-56521, H-59198, H-78956
WEINSTEIN, L H C-00626, C-00636, C-00941, *C-03503, C-11041, H-00631, H-00633, H-00920, *H-00964, H-00979, H-01506, *H-02382, *H-04728, H-06404, H-10150
WEIR J B D V G-15040
WEISBURD M I *A-48429
WEISKOPF G J C-25180
WEISS S *H-30225
WEISS, A J H-04683
WELCH B J A-49886, A-55407
WELKIE, G W H-00788, H-02516, H-12032
WELLARD H J *A-82279
WENDE E *N-46820
WENGER H H-40460
WENT F W *H-33089
WENTZEL K F H-23986, *H-28479, *H-36998, *H-41698, *H-46733, *H-48022
WENTZEL, K F *A-02653
WESENBERG H *B-49477
WEST N E *B-59861
WEST P W *C-20778, *C-23907
WESTPHAL B W *B-78890
WESTPHAL J D-22359
WESTPHALEN J C-21136, H-50729
WETT, T W *B-09902
WEWER B *G-32256
WHARTON H W *C-23573
WHEELER G L *H-52651
WHITCHURCH J B B-52094
WHITMAN, K B B-07664
WICKES H G JR *B-52094
WIEBE H H H-14121, H-16894, H-22499, H-24548, H-64588
WIENER H A *A-19400
WIESE A C H-52306
WILCOX S L *K-68224
WILDE G *B-48814, B-64506, B-81995
WILINSKI, F T G-06288
WILKNISS P E *D-33017, D-62438, *E-30126, *E-43424
WILLARD H H *C-27331
WILLIAM A *H-45345
WILLIAMS C R *A-26258, *C-39288
WILLIAMS D T *C-80259
WILLIAMS H H C-18344
WILLIAMS W J C-79843
WILSON H H *A-69353, *A-79774, *B-72656
WILSON N G-78873
WILSON W I B-75387
WILSON, W L *C-07710
WINDISH J P G-37791
WING J C-79003
WINKHAUS G B-64506, B-81995
WINKLER H D *B-66947
WINTERS W S H-16245
WINTERS, W S C-01793
WISLICENUS H *H-39537
WITHERSPOON A M H-65558
WITTBOLD H A B-17463
WITTE K H-18271
WITTES D T N-44066
WOEHLBIER W C-18264, *H-18270, H-24330
WOHLERS H C *C-22812
WOHLERS, H C *H-05612
WOJCIK K A-79511
WOLFF A *I-56143
WOLFRAM W *B-38587
WOLFROM W *B-69528
WOLFSON M R *A-50242
WOLLISH E G C-24310
WOLTING H G H-30299
WOLTZ S S *H-37403, *H-60560
WOLTZ, S S *G-01674, *H-01705
WONDRAEZEK W *B-48143
WOOD F A *H-45557
WOOD J H H-45663
WOOD R *A-51282, C-16801, C-21730
WOOD, F A *A-12557
WOODRUFF G N H-17109
WOODRUFF, G N H-06404
WOODWARD K R D-26086
WYATT E S B-22040
WYSZYNSKA H *C-20030, *C-20595, C-52101

Y

YAGOME K C-12451
YAHAGISAWA S *A-42054
YAJIMA T A-32855
YAMADA Y B-28786
YAMAGUCHI A A-49617
YAMAGUCHI C H-83721
YAMAGUCHI F *B-31889
YAMAKI N *C-71044
YAMAMOTO K B-71472
YAMAMOTO N *K-31968
YAMAMOTO S G-81181
YAMAMOTO T A-74512, G-79796, H-30805, H-30806, H-31124, *H-71098, *H-74721, H-74722, H-79309, *H-80085, *H-82146, H-83723
YAMAMURA S S C-23569, *C-24456, *C-24546
YAMANE T *C-80227
YAMASAKI M A-58402, B-58380
YAMASAKI Y B-28783
YAMASHITA H *B-70659
YAMASHITA S C-28530, G-40920, *L-81399
YAMASKI Y *H-42601
YAMATE N C-12451, *C-15171, *C-26122
YAMATE, N *B-07549
YAMATOMO T *H-54597
YAMAUCHI T G-30183
YAMAZAKI Y H-20708, H-28647
YAMAZOE F H-16399, *H-19211, *H-23988, *H-48639, *H-50415, *H-52928, *H-79972, *H-79973, *H-79974, *H-80067, *H-81671, *H-83797, H-83885, *H-84048
YANAGISAWA S C-29467, *C-38917, *C-47218, *C-69174
YANAKA T *A-82353, D-66083, H-58777
YANG, S F *H-05398, *H-05399
YAO M H-59327
YARMAK M K C-36125
YASUDA R B-64977
YASUDA S K *C-26259
YATAZAWA M C-50093, *H-50503, *H-50505
YATOMI K H-40899, H-84545
YAZAKI K G-81018, H-79633
YELNICHNYKH L N G-41685
YENNAWAR P K A-60283
YERKES W D JR H-24566
YOCOM J E *I-27060, *L-19064
YOCOM, J E *I-07553
YOKOHATA A C-41719
YOKOTA N *B-73175
YOPP J H *H-13474
YOSHIDA M B-28783, H-83182, L-82278
YOSHIDA T G-74822, H-49434, H-76901, H-79633
YOSHIDA Y *H-80079
YOSHIDA, Y *C-03908, *G-03246
YOSHIHARA T *B-47125
YOSHIKAWA H B-28786, *G-83179, H-20707
YOSHIMURA K B-70658
YOUNG L H B-81645
YOUNG M J *H-60907
YU H H S C-69152
YU M H *C-20701, C-2[illegible]441, *H-15404, *H-42907, H-56213
YU, M H H-12032
YUGE S B-30814
YUKITAKE T B-64898, B-68633
YUMIBA Y H-32714, H-84557
YUMOTO S A-58402
YUNGHANS R S *D-17986, *D-52575

Z

ZABEL H W *B-26244
ZAIKA P K A-63661
ZAMPOL SKAYA L M B-13771, F-15927
ZANON, D A-01125
ZAWADZKA, E *C-00450
ZAYTSEV V A *B-58632
ZHAROV V P C-79835
ZHUKOV V I *A-63661
ZHULIN N V *B-38188

ZIEGER E *H-41696
ZIELENSKI L F C-20540, C-26396
ZIELENSKI, L F C-01313, C-07763
ZIETZSCHMANN O *H-45781
ZIMMERMAN P W *H-20158, *H-40202
ZIMMERMAN, P W H-04678, H-04679, *H-04732, *H-04984
ZIPKIN I G-28556
ZIPKIN, I *H-04917
ZIZKA J *B-38439
ZOBER A G-80078
ZOENRNER, A *C-05620
ZOLTY S *C-18696
ZUBER R H-24395, H-28446, *H-28474, H-32535, H-32536, H-32539, H-33606, *H-40368
ZUENDORF U *A-55922
ZURLO N *C-43570, *C-49992
ZUZUKI M C-19500

Preceding page blank

SUBJECT INDEX

A

ABATEMENT A-25305, A-35985, A-38657, A-41650, A-42675, A-42680, A-45145, A-47061, A-47143, A-47954, A-47962, A-47963, A-60729, A-79511, A-80238, B-09902, B-18144, B-24683, B-26911, B-29680, B-41569, B-46050, D-09590, D-26702, D-47976, D-49860, D-56792, H-25499, K-28466, K-34063, L-06939, L-09677, L-17188, L-19064, L-19434, L-24010, L-24481, L-27677, L-28349, L-29421, L-29504, L-29598, L-29818, L-30620, L-32173, L-32245, L-32272, L-32354, L-32789, L-32884, L-35795, L-37943, L-38669, L-39749, L-40461, L-41455, L-42021, L-42188, L-42810, L-42873, L-42874, L-44054, L-46561, L-48788, L-61705, L-83965, N-28923, N-37027, N-46820, N-50748, N-50867, N-64545

ABSENTEEISM D-33108

ABSORPTION (CONTROL) A-01125, A-28652, A-47962, A-55212, A-55601, B-04368, B-07552, B-09902, B-10372, B-10618, B-12288, B-13676, B-14444, B-15813, B-16555, B-17463, B-17485, B-18641, B-18698, B-18699, B-19212, B-21795, B-22484, B-22598, B-22923, B-24033, B-24110, B-24117, B-24355, B-24834, B-25135, B-25178, B-25658, B-26745, B-29403, B-30276, B-30519, B-31708, B-32384, B-33918, B-33971, B-35106, B-35111, B-35448, B-37115, B-37745, B-38439, B-38445, B-38504, B-38587, B-38593, B-40251, B-41839, B-41932, B-42078, B-42458, B-43299, B-45468, B-45707, B-45757, B-45846, B-46086, B-47054, B-47341, B-47466, B-47680, B-48143, B-49420, B-50154, B-50652, B-51101, B-51755, B-52445, B-53603, B-53620, B-53868, B-53875, B-55524, B-55678, B-56531, B-58632, B-60075, B-60282, B-61741, B-61935, B-62165, B-63474, B-64898, B-65640, B-66618, B-66624, B-66947, B-67136, B-67137, B-67217, B-69131, B-69191, B-69528, B-70537, B-71412, B-71623, B-72038, B-73175, B-76512, B-77475, B-78814, B-81256, B-83198, C-00626, C-04105, C-04687, C-06112, C-06962, C-07710, C-09560, C-09770, C-10632, C-12100, C-23947, C-24603, C-27044, C-29771, C-35956, C-38741, C-40211, C-40705, C-44238, C-44552, C-50337, C-53987, C-55858, C-55923, C-60553, C-61995, C-73127, D-24717, D-32679, D-62438, G-10842, G-19880, G-24126, G-25946, G-26461, G-26743, G-28037, G-31319, G-52686, H-00187, H-00265, H-00301, H-00600, H-00964, H-01705, H-16152, H-19873, H-20573, H-20707, H-20872, H-20917, H-22624, H-23295, H-23386, H-23661, H-23988, H-24282, H-24358, H-24533, H-24548, H-24852, H-26092, H-26717, H-26916, H-28600, H-28647, H-29206, H-29736, H-30297, H-30301, H-30805, H-31527, H-32539, H-32897, H-33716, H-35964, H-38404, H-38417, H-42601, H-42958, H-43493, H-44428, H-45776, H-46557, H-48291, H-51526, H-52397, H-56204, H-60937, H-73510, I-52320, N-20495

ABSORPTION (GENERAL) A-15452, A-43014, B-24033, B-24333, B-28709, B-31889, B-33918, B-35106, B-35111, B-40381, B-40712, B-44716, B-47086, B-47341, B-50937, B-52445, B-53603, B-53620, B-53868, B-54799, B-59679, B-60255, B-61935, B-63775, B-65640, B-69131, B-72038, C-22877, C-29426, C-55858, C-66753, L-39306

ABSORPTION PHENOMENA B-80213, C-76030, C-79835, G-84236, H-79129, H-80536, H-83885

ACETALDEHYDE H-46338

ACETIC ACID A-37190, B-26745, C-00264, C-29771, D-31371, G-10362, H-28427, H-36742, H-40202, H-59198, H-67457, I-40510

ACETONE A-32855, B-42078, C-20650, C-45802, C-65118, C-80259, G-84260, K-51057

ACETYLENES A-03129, A-18449, C-39719, C-66753, E-43855, E-76047, F-03062, F-59528, G-48068, G-84260

ACID SMUTS A-17076, A-17377, A-29532, A-31529, C-24970

ACRIDINES B-24683, N-66750

ACROLEIN A-32855, A-37190, C-12451, C-43985, C-47218, C-67116, L-29504

ACUTE G-01047, G-01794, G-04983, G-11467, G-18987, G-27379, G-28139, G-30145, G-30841, G-32256, G-33505, G-33872, G-34398, G-34861, G-35569, G-37795, G-39219, G-39497, G-41036, G-41706, G-43323, G-44594, G-44867, G-46085, G-49223, G-49448, G-60228, G-60748, G-67440, G-68551, G-72961, H-00301, H-04848, H-06404, H-10841, H-11452, H-14678, H-16244, H-17109, H-20690, H-21364, H-23624, H-25769, H-31733, H-32714, H-36742, H-39887, H-39902, H-40472, H-41362, H-44345, H-47286, H-49644, H-50163, H-54297, H-59028, H-63626, H-67453, H-68575, N-66750

ADAPTATION G-35670, H-22930, H-48022, H-76451

ADSORPTION (CONTROL) A-01125, A-40344, A-43270, A-48231, A-55601, B-07549, B-10618, B-12288, B-12465, B-14692, B-15322, B-19177, B-19487, B-22853, B-29403, B-35106, B-36532, B-37536, B-42078, B-45846, B-47341, B-47680, B-50868, B-51101, B-52172, B-56528, B-57706, B-58993, B-60075, B-60206, B-60282, B-61273, B-62165, B-63474, B-63784, B-64070, B-64506, B-64977, B-69131, B-70840, B-71297, B-71623, B-72656, B-78814, B-80213, B-81645, B-83134, C-00126, C-04540, C-06983, C-24603, C-26707, C-27044, C-29771, C-35956, C-44933, C-61957, C-73471, D-32679, F-21389, F-57580, F-57581, G-52638, K-66860, N-20495

ADSORPTION (GENERAL) A-15452, A-63661, B-35106, B-37603, B-42083, B-47341, B-63775

ADSORPTION PHENOMENA C-80573, E-79132

ADVISORY SERVICES L-29598, L-42810, L-46561

AERODYNAMICS B-04368, N-20495

AEROSOL ATOMIZATION H-04688, H-37792

AEROSOLS A-00375, A-04068, A-05601, A-08486, A-08882, A-09785, A-11916, A-12631, A-17076, A-23865, A-28038, A-32060, A-36045, A-38657, A-42676, A-47954, A-48946, A-49924, A-60728, A-60827, A-63661, A-81169, A-82192, B-05567, B-18699, B-19571, B-24110, B-36532, B-38439, C-06279, C-09983, C-12451, C-25617, C-27044, C-29771, C-32450, C-36125, C-39871, C-41624, C-42375, C-43981, C-44881, C-51599, C-60278, C-61851, C-61859, C-81439, C-84660, D-09590, D-33017, D-34008, D-44799, D-50550, D-58218, E-30126, E-43424, E-62869, E-78933, F-15927, G-07961, G-11942, G-38616, G-40597, G-41687, G-61467, G-68583, G-71948, G-72961, G-73658, H-00301, H-01809, H-03395, H-05485, H-08884, H-16150, H-21189, H-21364, H-29736, H-49778, H-49779, H-76233, I-24308, I-58585, L-40889

AFRICA B-51720, C-26713, F-57581, G-44590, H-26795, H-55066, H-56625

AGRICULTURAL CHEMICAL PLANTS A-05139, A-05140, A-09690, A-09695, A-09696, A-13353, A-13699, A-17344, A-17357, A-22[illegible]7, A-25305, A-26136, A-26258, A-26329, A-28282, A-31935, A-32139, A-32855, A-33735, A-34018, A-35592, A-35985, A-39460, A-43270, A-43816, A-44681, A-46119, A-47954, A-48429, A-55601, A-60281, A-60283, A-63661, A-67748, A-70069, A-70727, A-76411, A-76459, A-77[illegible]3, A-79511, A-82269, A-82353, A-82944, A-84479, B-13813, B-17485, B-18536, B-19210, B-20436, B-21034, B-22598, B-22913, B-34117, B-24355, B-25038, B-26674, B-27569, B-27835, B-28034, B-32231, B-32232, B-32384, B-36405, B-36475, B-36716, B-37080, B-37115, B-37603, B-37745, B-37914, B-38587, B-39104, B-40251, B-43533, B-43863, B-43972, B-44793, B-44979, B-45004, B-45254, B-45707, B-46086, B-47095, B-48143, B-51720, B-53603, B-58466, B-58632, B-59679, B-60282, B-63474, B-64092, B-65923, B-67136, B-67137, B-67742, B-70840, B-71472, B-80863, B-81040,

B-81772, B-81773, B-81944, B-84418, C-14288, C-18230, C-20701, C-28530, C-36693, C-40211, C-61896, C-80935, D-24801, D-28188, D-33108, D-47982, D-48791, D-49260, D-49860, D-71272, E-29315, E-37037, F-15927, G-15555, G-16874, G-25469, G-26846, G-33510, G-33511, G-39219, G-79634, G-83798, H-15838, H-18226, H-19656, H-20707, H-23661, H-24395, H-25499, H-27021, H-28446, H-28830, H-28899, H-30301, H-32291, H-32588, H-32897, H-33290, H-33906, H-36787, H-38017, H-38404, H-38417, H-38574, H-39537, H-39627, H-39923, H-40201, H-45007, H-45130, H-46217, H-47385, H-49561, H-49647, H-53370, H-54066, H-55066, H-56874, H-58941, H-59935, H-65715, H-70752, H-74624, H-77050, H-79635, H-80064, H-81771, I-39031, J-28805, J-30226, K-66916, L-37747, L-48788, L-84415

AGRICULTURAL SERVICES A-43270, A-71262, H-00137, H-00301, H-21189, H-22092, H-30368, H-32536, H-37792, H-38568

AGRICULTURE INDUSTRY A-00340, A-03129, A-05090, A-12631, A-37190, A-39587, A-43270, A-47939, A-71262, B-06587, B-08344, B-09664, B-18144, B-24117, B-25038, G-06497, G-10842, H-00137, H-00301, H-08884, H-21062, H-21189, H-22092, H-23624, H-23661, H-23988, H-24282, H-24366, H-25499, H-30368, H-32536, H-32539, H-33606, H-36998, H-37567, H-37792, H-38568, H-39923, H-43226, H-50415, L-37747, L-37943

AIR CONDITIONING EQUIPMENT B-33620, I-23108

AIR POLLUTION EPISODES A-00220, A-00375, A-32060, A-58334, B-48879, C-24603, C-66606, D-09590, D-73835, G-01794, G-03394, G-05833, G-11467, G-18785, G-24580, G-27379, G-30788, G-38616, G-39219, G-40597, G-44867, G-49756, G-71484, G-84260, H-08884, H-29277, H-61496, H-67026, H-79976, K-14772, K-31968, K-36823, K-38197, K-60887, L-29818, L-32245, L-40889, L-42188, L-44054, L-50180, L-76847, L-81220, N-28923, N-49170, N-50867

AIR POLLUTION FORECASTING A-23865, C-27248, C-44285, E-29315, E-29774, E-59075, E-59234, E-64013, I-24122, L-64940, L-77234, N-28923

AIR QUALITY CRITERIA A-41650, A-83543, B-25638, B-70428, C-31115, C-36800, C-58278, D-09590, G-22628, G-22629, G-34398, G-35670, G-37139, G-52029, G-68551, H-10673, H-13985, H-29206, H-38343, H-65558, J-76213, K-07605, K-08420, K-13173, K-14772, K-17375, K-25933, K-26738, K-36823, K-41266, K-41267, K-41295, K-46081, K-47672, K-58899, K-60887, K-67267, K-68224, K-71991, L-19064, L-64940

AIR QUALITY MEASUREMENT PROGRAMS A-00340, A-02312, A-03450, A-47945, A-48048, A-58402, A-69309, A-76274, B-07549, B-09664, B-24683, B-25638, C-12334, C-26713, C-27248, C-29426, C-36002, C-36693, C-42926, C-44285, C-46034, C-56572, C-58278, C-61103, C-68944, C-80573, D-01872, D-09590, D-09658, D-10619, D-19145, D-23760, D-23845, D-24736, D-24801, D-25593, D-26086, D-26702, D-28097, D-28188, D-29040, D-30705, D-31371, D-31396, D-33080, D-33309, D-33858, D-34008, D-35764, D-36806, D-37473, D-37607, D-37994, D-39054, D-39737, D-40896, D-41979, D-43317, D-44267, D-44799, D-47976, D-48791, D-48850, D-49118, D-49260, D-49860, D-50307, D-50550, D-50690, D-50744, D-51929, D-52575, D-54881, D-55187, D-56463, D-56464, D-56465, D-58339, D-58427, D-60574, D-61140, D-63186, D-67690, D-70500, D-74121, D-77485, D-77512, E-37037, E-37639, E-49185, E-49433, E-59075, G-38106, G-49271, G-50318, G-50371, G-62177, G-66044, G-68520, G-74369, H-00737, H-05724, H-13474, H-42923, H-45663, H-46338, H-48377, H-52698, H-59327, H-60690, H-64166, H-70487, H-70984, H-74459, H-74588, H-74617, H-76233, H-77050, H-77329, H-77377, H-77390, H-81288, J-43002, K-31968, K-36823, K-69550, K-72145, K-80854, L-24481, L-25542, L-29598, L-32354, L-33495, L-37943, L-40889, L-42021, L-42188, L-42873, L-42874, L-44054, L-46561, L-50180, L-52026, L-57270, L-73839, L-76397, L-80894, L-81220, L-82278, N-32254, N-50867, N-65407

AIR QUALITY STANDARDS A-00896, A-01687, A-03129, A-17344, A-22547, A-27930, A-31315, A-31333, A-33735, A-36377, A-37190, A-37721, A-47410, A-47945, A-47954, A-47959, A-50242, A-55601, A-63661, A-79511, A-80238, B-19177, B-19212, B-25135, B-25638, B-29680, B-30519, B-30814, B-38476, B-63474, C-03119, C-41719, C-46034, D-06809, D-24736, D-25593, D-26702, D-30705, D-33576, D-37823, D-47982, D-49118, D-54881, D-56463, G-01794, G-06485, G-12282, G-32596, G-32601, G-32605, G-32606, G-33509, G-33510, G-33511, G-33561, G-34398, G-35569, G-36947, G-37139, G-38721, G-41684, G-41685, G-41686, G-41687, G-41688, G-50161, G-66668, G-68551, G-71484, G-71617, G-74580, H-00737, H-02379, H-10673, H-23624, H-23986, H-26734, H-29991, H-30297, H-38568, H-40916, H-47014, H-65558, H-79976, K-03032, K-03582, K-11414, K-13173, K-14772, K-17375, K-19750, K-26738, K-27010, K-28466, K-31968, K-33107, K-34063, K-36823, K-37472, K-38197, K-41266, K-41267, K-41295, K-41682, K-44310, K-46081, K-47672, K-51057, K-51212, K-51229, K-58638, K-60180, K-60887, K-68582, K-69550, K-71991, K-72145, K-74109, K-80854, L-06349, L-06734, L-06939, L-09677, L-19064, L-19434, L-29504, L-29598, L-31492, L-32789, L-32884, L-33495, L-35795, L-37747, L-37943, L-38669, L-39306, L-41455, L-42021, L-42188, L-44054, L-46586, L-47380, L-48788, L-50180, L-64940, L-73836, L-78484, L-82278, N-50748

AIR RESOURCE MANAGEMENT B-09664, G-05833, L-28349, L-41455, L-61705, N-63463

AIR-FUEL RATIO A-33853, B-33554, N-20495

AIRCRAFT A-09785, A-12557, A-42054, B-37402, C-69152, D-33017, E-72995, G-27895, G-72961, K-19818

ALASKA A-39862

ALCOHOLS A-09785, A-15452, A-32855, A-37190, A-39460, A-48116, A-52664, A-66977, A-79280, B-14692, B-62165, B-75204, C-09770, C-09983, C-20030, C-31115, C-38670, C-39136, C-39516, C-42928, C-43985, C-44933, C-45802, C-47218, C-48392, C-50936, C-61103, C-65118, C-67116, C-83592, D-17102, D-31371, D-39737, D-50690, D-60574, D-63186, G-07098, G-34398, G-84260, H-07046, H-15404, H-25366, H-47014, H-84484, K-28466, K-41682, K-51057, K-74109, L-29504, L-32173, L-32245, L-37747, N-65407

ALDEHYDES A-00220, A-00375, A-08882, A-09785, A-23561, A-23865, A-29532, A-30218, A-30517, A-31315, A-31529, A-32855, A-34018, A-37190, A-39460, A-40344, A-42680, A-43270, A-44566, A-45145, A-48231, A-51100, A-61570, A-72133, A-79280, B-29680, B-60864, B-62165, B-75204, C-00126, C-03527, C-06112, C-09983, C-12451, C-15171, C-20650, C-22458, C-22812, C-24603, C-26122, C-26707, C-27294, C-31115, C-32476, C-32534, C-35441, C-38280, C-38670, C-39719, C-42928, C-43672, C-43985, C-44933, C-47218, C-50337, C-59513, C-61103, C-65118, C-67116, C-69174, C-80259, C-83592, D-23845, D-31371, D-33425, D-34008, D-50690, D-60574, D-63186, D-78193, F-68048, G-01794, G-07098, G-26274, G-27379, G-61146, G-68583, G-73658, G-84260, H-05421, H-23295, H-46338, H-49778, H-51526, H-52928, H-53903, I-00695, K-41682, K-72145, L-17614, L-29504, L-32173, L-32245, L-44054, L-81220, N-04212, N-49170, N-66750

ALERTS C-66606, H-79976, K-31968, K-36823, K-38197, L-29818, L-32245, L-40889, L-42188, L-44054, L-50180, L-76847, L-81220

ALFALFA A-02312, B-02541, C-00941, C-18016, C-24886, E-70747, H-00187, H-00265, H-00266, H-00301, H-00631, H-00633, H-00964, H-01800, H-04923, H-04925, H-04984, H-08884, H-11456, H-12045, H-14247, H-17449, H-17710, H-20158, H-22084, H-22092, H-24036, H-24548, H-25230, H-31527, H-32771, H-38343, H-40202, H-44295, H-45009, H-45776, H-56204, H-71931, H-80067, K-07605, K-26738

ALGAE A-83543

ALKALIES AND CHLORINE PLANTS C-66753

ALKALINE ADDITIVES A-15452, A-34096, A-43014, A-63661, B-12288, B-16555, B-17463, B-18641, B-23182, B-24033, B-28889, B-29680, B-30276, B-30814, B-35111, B-41378, B-42083, B-44838, B-45707, B-45846, B-47086, B-47341, B-48480, B-48879, B-50937, B-51101, B-52445, B-59679, B-60075, B-60255, B-61935, B-63640, B-71472, B-72656, B-74480, B-74483, B-75387, B-78814, B-79079, C-21806, C-23575, C-55858, H-39537, L-39306

ALKALIZED ALUMINA A-34334, B-12288, B-18641, B-18830, B-26908, B-36755, B-64977

ALLERGIES A-00375, C-67116, G-01794, G-02539, G-07098, G-36751, G-40635, G-43636, G-61467

ALPHA PARTICLES A-59921, A-79043, C-27294, D-30058, D-56463, D-56464, D-56465

ALUMINUM A-01687, A-03129, A-05090, A-05601, A-06241, A-07650, A-08102, A-08748, A-09799, A-11341, A-11877, A-12470, A-12474, A-12476, A-12587, A-12622, A-12676, A-12692, A-12740, A-13615, A-13701, A-17116, A-17471, A-18656, A-23022, A-24370, A-26136, A-30296, A-31283, A-31333, A-31935, A-34018, A-35592, A-40182, A-42676, A-42731, A-44490, A-44605, A-45858, A-47061, A-49886, A-50018, A-53874, A-55212, A-55407, A-58939, A-60728, A-68807, A-68823, B-04368, B-06587, B-07815, B-08344, B-09902, B-13676, B-15372, B-16962, B-17463, B-17485, B-18641, B-18698, B-18699, B-19210, B-19487, B-22853, B-23370, B-24116, B-25135, B-25195, B-26279, B-26317, B-28320, B-28786, B-30519, B-31567, B-32712, B-32963, B-33918, B-35111, B-35513, B-36552, B-36755, B-37293, B-37544, B-37603, B-38082, B-38188, B-38445, B-38593, B-38775, B-38874, B-40414, B-41418, B-42287, B-43299, B-43840, B-44343, B-44638, B-44838, B-45078, B-45380, B-47256, B-47463, B-48811, B-48814, B-49477, B-51845, B-52094, B-52172, B-52179, B-52838, B-53603, B-53620, B-53875, B-54310, B-55524, B-56528, B-57706, B-58993, B-59459, B-59679, B-60206, B-60255, B-61273, B-67954, B-69191, B-70659, C-02042, C-04038, C-09770, C-10632, C-17098, C-28530, C-29220, C-29738, C-30793, C-30958, C-38905, C-40409, C-40705, C-41064, C-43570, C-44689, C-49476, C-52206, C-60951, C-68086, D-07579, D-13838, D-14066, D-17642, D-27254, D-32666, D-33108, D-33309, D-37823, D-39182, D-46791, D-53889, D-66083, E-14897, E-37013, E-37639, E-49433, E-59075, E-64013, F-32952, F-39861, G-10203, G-10333, G-13215, G-13700, G-14112, G-14319, G-15040, G-19215, G-19880, G-23003, G-26846, G-28754, G-29415, G-30183, G-31319, G-33766, G-37282, G-37569, G-37684, G-38106, G-38942, G-39799, G-40527, G-40635, G-40920, G-44362, G-47906, G-49271, G-50371, G-50414, G-56931, G-56933, G-62177, G-62596, G-64484, G-68520, H-08884, H-09553, H-10342, H-13203, H-14678, H-15604, H-18269, H-18270, H-18704, H-19124, H-19358, H-20872, H-21062, H-22085, H-22092, H-22496, H-23386, H-23579, H-23580, H-26978, H-29277, H-32286, H-32289, H-32344, H-32516, H-32535, H-32536, H-32539, H-32672, H-32673, H-32897, H-33906, H-36883, H-36996, H-37480, H-38017, H-38404, H-38417, H-38568, H-39159, H-39684, H-39895, H-39923, H-40201, H-40472, H-40599, H-44428, H-45604, H-45663, H-46217, H-46719, H-46721, H-49561, H-52829, H-52994, H-53025, H-58506, H-58777, H-58941, H-60690, H-61000, H-65715, H-77377, I-00085, I-23106, I-40510, I-40833, I-46606, J-29923, J-30696, J-39910, J-48171, K-51212, K-66860, L-06754, L-20273, L-24010, L-28014, L-29598, L-38573, L-45783, L-46561, L-46586, L-59722, L-66700, N-14783

ALUMINUM COMPOUNDS A-03601, A-06241, A-09785, A-09799, A-12476, A-26258, A-29532, A-30447, A-42731, A-50938, A-51100, A-52741, A-80994, B-10372, B-11686, B-21034, B-24110, B-24117, B-25178, B-28783, B-30519, B-32384, B-32963, B-38188, B-38593, B-41418, B-43299, B-47186, B-47256, B-53620, B-55678, B-58993, B-59459, B-80950, C-02042, C-10632, C-16801, C-24018, C-24114, C-24124, C-24279, C-27331, C-29738, C-42928, C-83442, D-21419, D-58427, E-29910, E-43424, F-04468, G-10203, G-10362, G-26846, G-32606, G-41687, G-49271, H-03860, H-05004, H-10342, H-13213, H-13474, H-18269, H-24944, H-25661, H-25665, H-28443, H-37346, H-45160, H-46719, H-46721, H-67347, I-40833

ALUMINUM OXIDES A-17471, A-40344, A-44605, A-60728, A-64926, B-22853, B-24116, B-28320, B-31567, B-35513, B-38299, B-42458, B-43863, B-44838, B-48814, B-52172, B-56528, B-57706, B-60206, B-63784, B-76008, C-10632, C-42928, C-60278, D-39182, F-39861, G-10362, G-84233, H-16567

ALUMINUM PRIMARY PRODUCTION A-83637, B-76232, B-80213, B-81995, G-83798, G-84233, H-79129, H-83730, H-83851, J-76213, K-81864, K-84395

ALUMINUM SECONDARY SMELTING AND REFINING A-82269, A-82353, A-82944, A-83637, B-77475, B-81645, B-82918, C-80935, G-83798, G-84233, H-79633, H-80064, H-80189, H-82208, H-83730, H-83851, H-84551, H-84553, J-76213, L-81399

ALVEOLI G-01047, G-30788, G-30841, G-32607, G-40597, G-41684, G-41706, G-79623, G-84260

AMIDES A-11916, C-45802, H-04728

AMINES A-01125, A-39460, A-43270, A-79280, B-41932, B-79711, C-06279, C-36125, C-38670, C-39136, C-39719, C-42928, C-61103, C-65118, C-80259, C-83592, F-68048, G-04927, G-34398, G-41706, G-52029, G-72961, K-51057, K-72151

AMINO ACIDS A-11916, C-03478, G-01338, H-04728, H-05398, H-05399, H-19703, H-62548, H-79972

AMMONIA A-05040, A-05139, A-05140, A-09690, A-09695, A-09696, A-09785, A-11916, A-12741, A-12747, A-15452, A-18449, A-23865, A-26329, A-28038, A-30218, A-30517, A-32855, A-34018, A-35985, A-36377, A-39460, A-40344, A-40600, A-43270, A-45858, A-46119, A-50938, A-60283, A-66977, A-67806, A-70069, A-71262, A-72133, A-80238, B-24333, B-25038, B-32231, B-32232, B-32384, B-35106, B-36405, B-36475, B-37080, B-37745, B-37914, B-45707, B-47341, B-59679, B-60282, B-62165, B-63474, B-67742, B-70840, B-75204, B-79711, B-84418, C-03119, C-05078, C-05586, C-06962, C-09983, C-11574, C-17128, C-20650, C-22458, C-22812, C-24022, C-24603, C-24970, C-28126, C-30840, C-31115, C-32534, C-35441, C-35737, C-35956, C-36125, C-38280, C-38670, C-39136, C-39719, C-40422, C-41763, C-43981, C-43985, C-44253, C-47218, C-50337, C-59513, C-61851, C-65118, C-65846, C-66606, C-69174, C-74942, C-79842, C-79843, C-80259, C-84660, D-17102, D-18537, D-22348, D-23845, D-25593, D-33108, D-37994, D-41979, D-44799, E-29774, F-16218, F-18863, F-57581, F-59528, F-68048, G-01794, G-07098, G-26274, G-27379, G-34398, G-48068, G-57299, G-79848, G-84260, H-00301, H-03395, H-04984, H-08884, H-12042, H-12155, H-13474, H-16152, H-17710, H-18319, H-20158, H-23295, H-23661, H-23988, H-24035, H-28474, H-28475, H-30473, H-32982, H-35613, H-36159, H-36742, H-39537, H-40202, H-40368, H-41696, H-42923, H-43492, H-45007, H-45022, H-45130, H-45345, H-47014, H-49644, H-49778, H-49779, H-50677, H-52928, H-59028, H-67026, H-67056, H-67348, H-67457, H-70776, H-70984, H-78580, I-00695, I-23108, I-39031, I-40510, I-58585, I-69995, J-55161, K-19818, K-41682, K-44310, K-60180, K-72151, L-06754, L-17188, L-24481, L-25542, L-29504, L-29818, L-32789, L-33722, L-39306, L-47380, N-04212, N-63463, N-64937, N-66750

AMMONIUM CHLORIDE A-82269, B-28786, B-36405, C-24022

AMMONIUM COMPOUNDS A-00340, A-03565, A-05040, A-05139, A-05140, A-06371, A-09690, A-09695, A-09696, A-09785, A-11916, A-12741, A-12747, A-15452, A-18449, A-23865, A-26329, A-28038, A-30218, A-30517, A-31134, A-32060, A-32855, A-34018, A-35985, A-36377, A-39460, A-39862, A-40344, A-40600, A-43270, A-45858, A-46119, A-48429, A-50938, A-60283, A-66977, A-67806, A-70069, A-71262, A-72133, A-80238, A-82269, B-07552, B-24110, B-24117, B-24333, B-24834, B-25038, B-28786, B-32231, B-32232, B-32384, B-35106, B-36405, B-36475, B-37080, B-37745, B-37914, B-44793, B-45254, B-45707, B-47341, B-55180, B-59679, B-60282, B-62165, B-63474, B-67742, B-70840, B-75204, B-79711, B-84418, C-03119, C-05078, C-05586, C-06962, C-09560, C-09983, C-11574, C-17128, C-20650, C-22458, C-22812, C-24022, C-24603, C-24970, C-28126, C-30840, C-31115, C-32534, C-35441, C-35737, C-35956, C-36125, C-38280, C-38670, C-39136, C-39719, C-40422, C-41763, C-43981, C-43985, C-44253, C-47218, C-50337, C-59513, C-61851, C-65118, C-65846, C-66606, C-69174, C-74942, C-79842, C-79843, C-80103, C-80259, C-84660, D-17102, D-18537, D-22348, D-23845, D-25593, D-33108, D-37994, D-41979, D-44799, D-50307, D-55187, D-58218, E-29774, E-62869, F-16218, F-18863, F-57581, F-59528, F-68048, G-01794, G-07098, G-26274, G-27379, G-34398, G-39494, G-39810, G-48068, G-57299, G-68583, G-79848, G-84260, H-00301, H-03395, H-03860, H-04672, H-04984, H-08884, H-12042, H-12155, H-13474, H-16152, H-17710, H-18319, H-20158, H-23295, H-23661, H-23988, H-24035, H-28474, H-28475, H-30473, H-32982, H-35613, H-36159, H-36742, H-39537, H-40202, H-40368, H-41696, H-42923, H-43492, H-45007, H-45022, H-45130, H-45345, H-47014, H-49644, H-49778, H-49779, H-50677, H-52928, H-59028, H-67026, H-67056, H-67348, H-67457, H-70776, H-70984, H-78580, I-00695, I-23108, I-39031, I-40510, I-46606, I-58585, I-69995, J-55161, K-19818, K-41682, K-44310, K-51057,

K-60180, K-72151, L-06754, L-17188, L-24481, L-25542, L-29504, L-29818, L-32789, L-33722, L-39306, L-47380, N-04212, N-63463, N-64937
AMMONIUM SULFATE C-66753, N-66750
ANEMIA C-66753, G-33505, G-33872, G-44867, H-79631, K-41266
ANEMOMETERS A-31581, C-35956, E-04987
ANIMALS (NON-HUMAN) A-00375, A-00640, A-02312, A-11916, A-13699, A-22973, A-26258, A-28282, A-31935, A-32576, A-71273, A-81169, A-83543, B-02541, B-06587, B-09664, B-25433, B-75138, C-00126, C-01793, C-07719, C-20701, C-60410, D-33309, G-00165, G-01047, G-01426, G-01794, G-02539, G-03246, G-03394, G-04734, G-04927, G-04983, G-06288, G-07013, G-07917, G-08030, G-08031, G-08201, G-10247, G-10333, G-10362, G-11000, G-11444, G-11467, G-12282, G-12403, G-12547, G-12550, G-13215, G-13700, G-14126, G-14319, G-15040, G-16047, G-18809, G-21455, G-23711, G-24392, G-28041, G-30145, G-30385, G-30387, G-30841, G-32256, G-32596, G-32601, G-32606, G-33276, G-33505, G-33510, G-33511, G-33561, G-33872, G-35569, G-36411, G-36723, G-38616, G-39799, G-39810, G-39813, G-39924, G-39931, G-40635, G-41036, G-41224, G-41684, G-41685, G-41686, G-41687, G-41688, G-43277, G-43896, G-44593, G-44594, G-45055, G-45683, G-47807, G-49223, G-49448, G-50161, G-52147, G-52686, G-56931, G-56934, G-56959, G-57024, G-59073, G-61467, G-64484, G-66668, G-70519, G-71948, G-72083, G-72961, G-74821, G-74822, G-74823, G-79619, G-79623, G-79796, G-79848, G-79980, G-80857, G-81018, G-81250, G-84266, H-00600, H-00944, H-01092, H-03116, H-04544, H-04848, H-04850, H-04917, H-04918, H-04919, H-04923, H-04924, H-04925, H-04997, H-05004, H-05421, H-05612, H-06353, H-06354, H-09553, H-10711, H-11452, H-11456, H-11466, H-11469, H-12529, H-12533, H-12538, H-12540, H-12551, H-12553, H-12554, H-12556, H-13159, H-13203, H-13213, H-13985, H-17620, H-18268, H-18269, H-18270, H-18271, H-20015, H-20707, H-22887, H-23624, H-24944, H-25665, H-25735, H-25945, H-26718, H-26734, H-26742, H-26795, H-27907, H-27923, H-28031, H-28035, H-28679, H-28830, H-29206, H-29277, H-29736, H-29991, H-30297, H-31208, H-32291, H-32588, H-32672, H-32736, H-33290, H-35877, H-35992, H-37346, H-37480, H-38407, H-38417, H-39493, H-39607, H-39627, H-39895, H-39923, H-40201, H-40599, H-40916, H-41439, H-42857, H-43226, H-44295, H-44428, H-45781, H-46997, H-47286, H-48167, H-48193, H-48639, H-49316, H-49434, H-49561, H-52964, H-54597, H-59935, H-61000, H-61496, H-64427, H-65103, H-66035, H-66715, H-67453, H-68770, H-76901, H-77377, H-79633, H-80079, H-80535, H-80711, H-83145, H-83182, H-83258, H-84080, H-84089, H-84477, H-84527, H-84541, H-84545, J-28805, K-03582, K-31968, L-24010, L-25642, N-04212, N-12307, N-28923, N-66750
ANOXIA G-18987
ANTHRACENES G-07098
ANTHRACOSIS G-18987
ANTIBODIES G-61467
ANTICYCLONES G-18785
ANTIDOTES G-04927, G-36723, H-01092, H-20690
ANTIMONY COMPOUNDS A-18449, A-52741, A-60866, A-75077, B-77838, C-09770, C-27294, C-39719, C-75339, D-50307, E-43424, F-41543, G-71933, G-72961, I-08076
APPLES B-02541, C-28441, C-28462, H-04984, H-17892, H-32536, H-60907, H-80493
APRICOTS H-80067
AQUATIC ANIMALS A-83543
AQUEOUS SOLUTION SCRUBBING A-82192, B-78814, B-78890
AREA EMISSION ALLOCATIONS B-09664, K-33107, L-09677, L-32884, L-60630
AREA SURVEYS A-00340, A-02312, A-03450, A-47945, A-48048, A-58402, B-07549, C-29426, C-56572, D-09590, D-09658, D-10619, D-19145, D-26086, D-31371, D-33080, D-33309, D-34008, D-36806, D-37473, D-37607, D-37994, D-39054, D-39737, D-40896, D-41979, D-43317, D-44267, D-44799, D-47976, D-48791, D-48850, D-49118, D-49260, D-49860, D-50307, D-50550, D-50690, D-50744, D-51929, D-54881, D-55187, D-56463, D-56464, D-56465, D-58339, D-58427, D-60574, D-61140, D-63186, D-67690, D-70500, D-74121, D-77485, D-77512, E-37639, E-49185, E-49433, E-59075, G-38106, G-49271, G-50318, G-50371, G-62177, G-66044, G-68520, G-74369, H-05724, H-13474, H-42923, H-45663, H-52698, H-59327, H-60690, H-64166, H-70487, H-70984, H-74459, H-74588, H-74617, H-76233, H-77030, H-77329, H-77377, H-77390, H-81288, J-43002, K-31968, K-69550, L-29598, L-37943, L-40889, N-32254, N-65407
ARIZONA C-44710, H-00301, H-28031
ARKANSAS K-37472
AROMATIC HYDROCARBONS A-09785, A-32855, A-34334, A-39460, A-39862, A-42731, A-45145, A-47048, A-48572, A-72133, A-79280, B-41932, B-47677, B-62165, C-00264, C-04463, C-06112, C-09983, C-17128, C-20030, C-20595, C-20650, C-27294, C-31115, C-32534, C-38670, C-39136, C-44933, C-50337, C-60553, C-61103, C-67116, C-80103, C-80259, F-68048, G-01794, G-04927, G-07098, G-24153, G-30788, G-34398, G-68583, G-80197, G-84260, H-42857, H-46198, H-47014, K-41682, K-51057, L-29504, L-81220, N-66750
ARSENIC COMPOUNDS A-18449, A-22875, A-39862, A-40182, A-42680, A-59257, A-60728, A-60827, A-68912, A-73078, A-75077, A-76638, A-80238, A-81343, A-81931, B-18826, B-60864, B-75204, B-77838, B-80950, C-09983, C-17128, C-26707, C-27294, C-39136, C-39516, C-39719, C-42928, C-43985, C-48916, C-50936, C-53523, C-55789, C-61957, C-75339, C-79389, C-82552, C-83442, D-31396, D-42760, D-52578, G-11467, G-27379, G-28199, G-34398, G-36723, G-38616, G-39833, G-47807, G-52029, G-57701, G-67440, G-71536, G-71933, G-73658, G-80197, G-80857, H-04544, H-08884, H-11452, H-23624, H-25366, H-28475, H-32736, H-35877, H-38332, H-42924, H-43226, H-45467, H-47014, H-47286, H-48374, H-60760, H-61496, H-67348, H-67453, H-68394, H-76297, I-08076, K-10168, K-28466, K-41682, K-51057, K-68224, K-74109, L-37747, L-81220, N-04212, N-63463
ARSINE A-60827, B-75204, C-17128, C-79389, G-28199
ASBESTOS A-23561, A-26254, A-39460, A-42680, A-69039, A-80238, B-19177, B-60864, C-27248, C-61692, G-48693, G-52638, G-61467, G-71484, G-71536, G-79848, H-40368, K-68224, N-64545, N-66750
ASBESTOSIS B-19177
ASHES A-32702, A-34334, A-40471, A-46925, A-48572, A-52741, A-53295, A-53751, A-57231, A-59257, B-33554, C-50876, C-80103, D-33309, G-38721, H-21189, H-43622, L-30620, N-04212
ASPHALT A-09785, A-39460, A-40159, A-43272, H-23661, H-28477, H-30225, H-36742, H-45022, J-30696, L-06939, L-09677, L-37747, L-48788
ASPIRATORS C-28374, C-37799, C-40705, C-43986
ASTHMA A-00375, D-33108, G-01794, G-16874, G-18785, G-18988, G-43636, G-47905, G-48637, G-49164, G-50916, G-61467, G-73658, G-74369, G-83798, J-30226, N-64937
ATMOSPHERIC MOVEMENTS A-00220, A-07650, A-09785, A-28652, A-31581, A-32576, A-32702, A-48048, A-50018, A-66955, A-68703, A-79511, B-19571, B-25195, B-42083, B-45468, C-07710, C-22877, C-29771, C-36800, C-44177, C-48392, C-68944, D-01872, D-09590, D-22348, D-23760, D-26086, D-31371, D-32666, D-33017, D-33108, D-33858, D-36806, D-37502, D-39054, D-40896, D-43170, D-43317, D-44267, D-44799, D-48791, D-50550, D-54881, D-58218, D-58427, D-73835, D-77485, E-02325, E-05054, E-29023, E-33092, E-37013, E-37037, E-37639, E-44277, E-49433, E-76047, E-78793, G-18785, G-33510, H-16567, H-25661, H-28149, H-28647, H-30301, H-31527, H-32714, H-36996, H-38412, H-42601, H-51470, H-58777, H-60907, H-69162, H-80064, H-82435, I-27060, I-47291, L-40889, N-04212, N-63776, N-69692
ATOMIC ABSORPTION SPECTROMETRY C-79032, C-82552, C-82650, N-66750
ATTACK RATES G-05833, G-37791
AUSTRALASIA A-49886, A-55407, B-17485, B-21034, B-29403, B-41418, B-76232, B-80950, C-09560, E-79132, H-76233, L-44598
AUSTRALIA A-49886, A-55407, B-17485, B-21034, B-29403, B-41418, B-80950, C-09560, E-79132, L-44598
AUTOMATIC MEASUREMENT METHODS A-30517, A-42677, B-60849, B-60864, B-72139, C-00626, C-00636, C-00941, C-01313, C-01593, C-03503, C-04463, C-06279, C-11574, C-12451, C-18696, C-20540, C-21855, C-22458, C-22879, C-23767, C-24399, C-25647, C-26121, C-26396, C-28530, C-28671, C-29738, C-29771, C-29966, C-35737, C-36002, C-36693, C-37350, C-38280, C-39022, C-39871, C-40211, C-42375,

C-43979, C-43986, C-44285, C-49879, C-61103, C-65118, C-65846, C-66606, C-71044, C-71231, C-72015, C-77427, C-80573, C-80935, C-83442, D-27254, H-00301, H-00631, H-00964, H-06459, H-18770, H-50729, L-33495, L-81220, N-64545
AUTOMOBILES A-00375, A-09785, A-12557, A-23561, A-23865, A-29786, A-31315, A-32060, A-34018, A-36377, A-42054, A-47143, A-48946, A-68703, A-69309, A-76274, B-02541, B-07549, B-35106, B-37402, B-47731, C-35108, D-27254, D-33108, D-34008, D-49860, D-73835, G-30788, G-31319, G-50161, H-45130, H-76297, I-23108, J-30696, K-19818, K-71991, K-72151, L-17472, L-19434, L-24122, L-27677, L-31492, L-32789, L-77234, N-04212, N-21287, N-32254
AUTOMOTIVE EMISSION CONTROL A-33853, B-02541, B-07549, B-28502, B-33554, B-35106, B-37402, B-47731, D-49860, J-30696, K-71991, L-24122, L-25427, L-31492, N-20495
AUTOPSY G-04849, G-07013, G-07917, G-08031, G-25946, G-26743, G-36751, G-40597, G-54302, G-80857, H-04848, H-04923, H-05004, H-12554, H-76901
AZINES C-17128
AZO DYE C-25668, C-30014, C-31115, C-39008, C-48916, H-18319
AZOLES H-00301

B

BACTERIA A-32702, B-28502, C-22812, C-35956, F-28428, F-52013, G-02539, G-30788, H-33127, H-56241, H-62275, H-80573
BAFFLES A-15452, B-38115, B-40381, B-43299, B-45078, B-49023, B-52838
BAG FILTERS A-08102, A-09799, A-12740, A-15452, A-17076, A-40344, A-41650, A-41877, A-43270, A-44490, A-48429, A-60827, A-70069, A-76152, A-76190, A-81861, B-07815, B-10618, B-19487, B-21795, B-22484, B-22853, B-25135, B-28786, B-29680, B-30519, B-31567, B-36755, B-38115, B-43299, B-44638, B-45380, B-45544, B-45707, B-45757, B-47256, B-47677, B-47680, B-48814, B-49023, B-49477, B-52172, B-52179, B-58879, B-61935, B-63474, B-63775, B-64977, B-65640, B-66624, B-70658, B-70840, B-71796, B-77475, B-80213, B-81773, C-24118, C-35956, C-81439, K-33107, L-32884, L-38573
BALLOONS C-35956, E-04987
BANDING H-01250, H-05485, H-14968, H-16244, H-19656, H-21364, H-21687, H-57810
BARIUM COMPOUNDS A-09785, A-27595, A-27617, A-52741, A-60729, A-76638, A-80238, A-80994, A-81343, B-77838, H-13474, K-68224
BARLEY H-11466, H-16222, H-17449, H-17710, H-32280, H-34880, H-36994, H-36996, H-56204, H-70607, H-71931, H-78956, H-81495
BASIC OXYGEN FURNACES A-01528, A-26254, A-41877, A-42682, A-60866, B-10618, B-29680, L-09677
BATTERY MANUFACTURING A-09785
BEANS H-78956, H-80575
BEES G-81250
BEETS (GARDEN) H-80575
BELGIUM A-00375, A-48231, A-72133, G-18785, G-30788, G-39219, G-40597, H-11469, H-45345, K-68582
BENZENE-SOLUBLE ORGANIC MATTER D-43317, D-50307
BENZENES A-32855, A-42731, B-41932, B-47677, C-00264, C-20030, C-20595, C-20650, C-31115, C-38670, C-39136, C-50337, C-67116, C-80259, F-68048, G-07098, G-68583, G-84260, H-47014, K-51057, L-29504, L-81220
BENZO(3-4)PYRENE A-00375, A-38657, C-39762, C-48916, D-32666, D-34008, D-50307, G-11942, G-41706, G-49756, G-60625, H-39328, N-04212, N-46820
BENZOPYRENES A-00375, A-29786, A-34018, A-38657, C-26707, C-27294, C-39762, C-48916, C-84660, D-28097, D-32666, D-34008, D-50307, G-11942, G-41706, G-49756, G-60625, G-71484, H-39328, L-84415, N-04212, N-46820
BERYLLIOSIS A-00340, A-00640, A-00896, A-02312, A-03450, B-07664, C-00126, C-00260, C-00264, C-00450, C-00626, C-00636, C-00941, C-01313, C-01593, C-01793, C-02042, C-02565, C-02681, C-03119, C-03478, C-03503, C-03527, C-03550, C-03908, C-04038, C-04405, C-04458, C-04463, D-01872, F-02517, G-01096, G-01426, G-01674, G-04734, G-11000, G-28199, G-28429, H-00187, H-00301, H-00633, H-00788, H-00944, H-00964, H-01250, H-01506, H-01664, H-02379, H-02382, H-03549, H-03873, I-00695, K-03032
BERYLLIUM A-00375, G-07098, G-11000, I-40510, K-08420, L-06349, L-06734
BERYLLIUM COMPOUNDS A-00375, A-27595, A-39460, A-59257, A-73078, A-75077, A-76638, A-80238, A-81343, A-81931, B-28945, B-75204, B-75387, C-06494, C-23683, C-25617, C-25952, C-42928, C-43985, C-53523, C-61957, C-75339, C-82552, D-17102, D-50307, E-62869, F-04468, F-34948, G-01794, G-07098, G-11000, G-18987, G-19148, G-28199, G-28429, G-33276, G-33505, G-33872, G-34398, G-38616, G-38721, G-71933, G-73658, G-79848, H-13474, H-48374, K-08420, K-19750, K-47672, K-51057, K-51212, K-68224, L-06349, L-06734, N-04212
BERYLLIUM OXIDES G-11000, G-52638
BESSEMER CONVERTERS A-01528, L-09677
BETA PARTICLES A-59921, A-79043, C-11626, C-27294, D-30058, D-56463, D-56464, D-56465, H-10150
BIO-ASSAY C-67116, G-57024, H-00240, H-01250, H-80535
BIOCHEMISTRY A-11916, C-03478, C-42928, F-22219, G-01338, G-01426, G-52638, G-74822, G-80197, H-04728, H-05398, H-05399, H-06413, H-06681, H-13247, H-16900, H-19703, H-21498, H-25618, H-52306, H-62548, H-79972, H-83723
BIOCLIMATOLOGY A-00375, G-28019, G-49756, H-38568, H-40341, H-53376, H-57810, H-60961, H-63442, I-58585, N-46820
BIOLOGICAL FACTORS A-11916, C-03478, C-42928, F-22219, G-01338, G-01426, G-52638, G-74822, G-80197, H-04728, H-05398, H-05399, H-06413, H-06681, H-13247, H-16900, H-19703, H-21498, H-25618, H-52306, H-62548, H-79972, H-83723
BIOPSY G-07344, G-37282, G-40635, H-01092, H-04924, H-04997
BIRCH TREES H-80493
BIRDS G-03394, H-04544, H-11469, H-25665, H-32672
BISMUTH C-09770
BISMUTH COMPOUNDS A-60728, A-76638, A-81343, D-50307, E-29910, G-39833
BLAST FURNACE AND BASIC STEEL PRODUCTS M A-00896, A-01528, A-17344, A-17464, A-17471, A-30447, A-31333, A-32139, A-37752, A-38657, A-39635, A-40182, A-40344, A-41877, A-42682, A-43014, A-43272, A-45858, A-49617, A-75206, A-76122, A-76190, A-77522, A-81861, A-82269, B-04794, B-06587, B-07664, B-10618, B-23182, B-24683, B-25433, B-25638, B-25658, B-29680, B-40892, B-42172, B-45544, C-80935, C-82552, D-39737, H-29736, J-29923, L-09677, L-19434
BLAST FURNACES A-00896, A-01528, A-17344, A-32139, A-41877, A-42682, A-45858, A-49617, B-04794, B-24683, B-25638, B-29680, B-40892, B-45544, D-39737, H-29736, L-09677
BLOOD CELLS A-06241, D-34008, G-10203, G-11000, G-13215, G-13700, G-14112, G-19880, G-24392, G-28754, G-33872, G-37569, G-40920, G-41685, G-41687, G-43277, G-44594, H-13203, H-79633
BLOOD CHEMISTRY A-06241, A-11916, G-01426, G-04927, G-10203, G-13215, G-29415, G-33511, G-36411, G-36723, G-37569, G-38106, G-54302, G-56931, G-56934, G-56959, G-57024, G-60625, G-66668, G-68520, G-74822, G-74823, G-80857, H-04850, H-04923, H-05004, H-10843, H-12540, H-12554, H-12556, H-48167, H-49434, H-65103
BLOOD GAS ANALYSIS G-12403, G-24392, N-20495
BLOOD PRESSURE G-23711, G-49164, G-52029
BLOOD SERUM G-79619, G-79623, G-79634, H-79633
BLOOD VESSELS G-04849, G-14319, G-24494, G-25946, G-36723, G-40597, G-40635, G-52029, G-74823, H-01092, H-04923
BODIES OF WATER A-37996, A-76459, A-83543, B-24683, B-28034, B-28502, C-44710, D-09590, D-09658, D-30058, D-33017, D-42760, D-62438, E-29910, E-30126, E-43424, F-44721, G-67325, H-16150, H-28149, H-36996, H-80085
BODY FLUIDS G-13215, G-24720, G-79619, G-79623, G-79634, G-83798, H-66715, H-79633
BOILERS A-08816, A-30218, A-77367, A-77522, A-81745, B-10618, B-25638, B-35111, B-36552, B-40381, B-47086, B-60255, B-65638, C-35956, C-44238, C-49391, D-25593, D-49860, J-30696, K-31968, K-34063, K-37472, K-51212, K-58899, K-72151, L-09677, L-32884, L-73839
BONES A-13701, A-31935, B-09664, C-26744, F-26990, G-03246, G-04849, G-04983, G-06485, G-06497, G-08030, G-09575, G-10203, G-11000, G-11467, G-12282, G-12532, G-13215, G-13700,

G-14126, G-22551, G-22628, G-23763, G-24494, G-26743, G-26846, G-28037, G-28199, G-28429, G-28556, G-28754, G-29415, G-30183, G-31234, G-31319, G-32152, G-32601, G-32605, G-32606, G-33505, G-33561, G-33872, G-36947, G-37684, G-37795, G-38106, G-38942, G-39833, G-40920, G-41685, G-41686, G-41688, G-44589, G-44590, G-44593, G-44597, G-48636, G-48637, G-48697, G-49164, G-49271, G-49448, G-49607, G-50371, G-50414, G-51473, G-52686, G-56934, G-70519, G-74821, G-74823, G-79619, G-79623, G-79980, G-80078, G-81018, G-81250, G-83177, G-83798, G-84531, H-00600, H-00944, H-01092, H-04917, H-04918, H-04919, H-04923, H-04924, H-04997, H-05004, H-05421, H-05612, H-06353, H-06354, H-10841, H-11452, H-11466, H-11469, H-12533, H-13203, H-13213, H-18268, H-18269, H-18270, H-18271, H-20015, H-20707, H-24944, H-25945, H-26734, H-26742, H-28031, H-28035, H-28258, H-28679, H-32289, H-32588, H-32673, H-33290, H-33906, H-35992, H-38407, H-38417, H-39493, H-39607, H-39627, H-39895, H-39923, H-40201, H-40368, H-40599, H-41439, H-45781, H-46997, H-48639, H-49434, H-49704, H-52964, H-56428, H-64427, H-65103, H-68770, H-76901, H-80535, K-31968, K-41266

BORON COMPOUNDS A-18449, A-33853, A-39587, A-51100, A-60729, A-73078, A-76638, A-80238, A-81343, B-29114, B-45757, C-06279, C-06494, C-23517, C-37799, C-39719, C-42928, C-75339, C-82650, D-33017, E-29910, E-33092, E-40271, F-04468, G-71933, H-13474, H-15838, H-19539, H-24395, H-25499, H-28446, H-32539, H-33606, H-56788, K-68224

BREATHING F-07714, G-07098, G-07917, G-32596, G-32605, G-32606, G-37569, G-37795, G-52686, G-61646, G-71948, G-79623, H-76297, H-80064, K-41295

BRICK AND STRUCTURAL CLAY TILE WORKS A-79774, B-77816, L-77817

BRICKS A-33735, A-34096, A-36212, A-40159, A-42677, A-43272, A-49852, A-60729, B-06587, B-19177, B-19210, B-44121, B-52445, B-55678, B-56591, B-63775, B-66947, C-18264, D-25093, H-11157, H-23874, H-39493, H-46733, H-68122, I-07553, J-30696, L-37747, L-39306, L-67888, N-69692

BROMIDES A-09785, A-29786, B-14692, B-61954, C-18344, C-24018, C-43234, C-47218

BROMINATED HYDROCARBONS B-24683, C-27769, F-03062, K-10168

BROMINE A-17344, A-34018, B-77838, C-17128, C-80227, C-83442, D-34008, F-03062, F-13565, F-78035, G-43323, G-48068, G-71933, H-13474, H-36742, H-41362, I-40510, K-10168, K-51057, L-44054

BROMINE COMPOUNDS A-09785, A-29786, B-14692, B-61954, C-17128, C-18344, C-20650, C-24018, C-43234, C-47218, D-33017, D-52578, E-29910, G-48068, H-36742, H-45022, H-52397, H-79976, I-08076, I-23108, K-34063, L-29504

BRONCHI G-07098, G-08201, G-10362, G-32256, G-40597, G-61467, G-79619

BRONCHIAL CANCER G-07961, G-18987, G-41706

BRONCHITIS A-00375, A-22973, A-63661, D-33108, G-02539, G-07013, G-11467, G-11942, G-18987, G-18988, G-39494, G-40920, G-41706, G-43636, G-47905, G-48637, G-49164, G-50916, G-73658, G-74369, G-83798, G-84137, H-03766, H-08884, J-30226, N-64937

BRONCHOCONSTRICTION G-08702

BRONCHOPNEUMONIA G-47905

BUBBLE CAP TOWERS A-12476, A-12676, B-43299, B-45078, B-47054, B-47466, B-52838, B-60075

BUCKWHEAT H-80067

BUDGETING L-29598, L-73836

BUILD-UP RATES A-08882, A-31581, H-48374

BUILDINGS A-31134, B-04853, C-01349, C-20701, C-27330, C-28251, D-09590, E-37639, E-44030, F-04768, G-01674, H-00187, H-00265, H-00301, H-00979, H-01705, H-05324, H-06413, H-07255, H-16222, H-18770, H-20917, H-26711, H-28802, H-30298, H-30299, H-35880, H-44345, H-77325, I-73616

BURNING A-01687, A-40344, A-47143, B-26911, B-44979, C-23683, C-35956, D-09590, D-26702, H-01398, H-21189, L-32173, L-32245, L-32272, N-12307

BUSES A-34018, A-48849, B-07549, I-23108

BUTADIENES H-11100

BUTANES E-76047, F-25636, G-30145, G-44867

BUTENES F-25636, H-11100

BY-PRODUCT RECOVERY A-18323, A-30296, A-35592, A-43014, A-47188, A-47962, A-47966, A-60281, A-61570, B-07815, B-12127, B-13676, B-17463, B-17485, B-18536, B-18698, B-18826, B-19177, B-19210, B-20436, B-21795, B-22598, B-22853, B-22923, B-24033, B-24117, B-24333, B-24834, B-25038, B-25178, B-27835, B-28034, B-29114, B-29680, B-31567, B-31708, B-32384, B-32461, B-32712, B-32963, B-33620, B-36405, B-36755, B-37509, B-37745, B-39104, B-40251, B-40712, B-41378, B-41932, B-42991, B-43840, B-43863, B-43972, B-44793, B-45254, B-45707, B-45757, B-45846, B-47095, B-47731, B-48805, B-48811, B-49031, B-49420, B-49929, B-51720, B-52094, B-53867, B-53875, B-54799, B-57706, B-58466, B-58632, B-59230, B-60282, B-61273, B-64977, B-65923, B-67136, B-67137, B-67217, B-67700, B-67742, B-67846, B-69131, B-69528, B-69965, B-71297, B-80500, B-80863, B-81040, B-81944, B-82446, H-39537, L-38573, N-14783

C

CABBAGE B-02541, H-00301, H-13203, H-34880, H-80064

CADMIUM G-00165, I-40510, I-40833, I-46606, L-35795, L-37747

CADMIUM COMPOUNDS A-17471, A-27595, A-37721, A-40182, A-47959, A-51100, A-57231, A-60421, A-60728, A-60729, A-73078, A-74262, A-75077, A-76638, A-80238, A-81343, A-81931, B-50868, B-65640, B-72139, C-09560, C-28126, C-32476, C-38670, C-39136, C-39516, C-41719, C-41763, C-42928, C-43985, C-49509, C-50876, C-50936, C-53523, C-55789, C-61851, C-61957, C-64779, C-72017, C-75339, C-82552, C-83442, D-36806, D-49260, D-50307, D-51929, D-54881, D-76890, D-83399, G-00165, G-28139, G-28199, G-34398, G-36723, G-38721, G-46085, G-47807, G-50419, G-50916, G-52029, G-61146, G-71484, G-71933, G-73658, G-79848, G-84137, H-11474, H-32736, H-43226, H-45467, H-48374, H-50729, H-60760, H-61496, H-65179, H-67348, H-71078, H-77325, H-79976, H-84290, K-31968, K-33107, K-34063, K-38197, K-42039, K-44310, K-44377, K-51057, K-68224, K-69550, K-72151, K-74109, K-80854, L-27677, L-28349, L-29421, L-30620, L-32789, L-32884, L-35795, L-38669, L-76847, L-76965, L-82278, N-04212

CALCIUM COMPOUNDS A-04068, A-09214, A-09541, A-09785, A-09799, A-11916, A-12095, A-12919, A-27617, A-30296, A-34096, A-35592, A-37752, A-39460, A-42731, A-43272, A-43403, A-49852, A-51100, A-52741, A-64926, A-71477, A-75077, A-79567, A-80994, A-81931, B-22598, B-24355, B-25433, B-25658, B-28889, B-30814, B-31889, B-36716, B-38188, B-42172, B-42287, B-43863, B-43972, B-45757, B-46086, B-55180, B-56591, B-58380, B-59861, B-60075, B-62786, B-66947, C-04692, C-07710, C-12760, C-23573, C-24114, C-24970, C-26729, C-26744, C-28251, C-29738, C-33632, C-41020, C-41063, C-42928, C-44177, C-46443, C-75339, D-21419, D-27254, D-33017, D-49260, E-40271, F-26990, F-34948, G-04145, G-06485, G-07344, G-07961, G-10362, G-14126, G-23763, G-26743, G-28556, G-32256, G-33561, G-48636, G-48637, G-52029, G-52638, G-84236, H-00631, H-00979, H-02200, H-03860, H-04672, H-04919, H-04925, H-04997, H-05004, H-06342, H-10841, H-10843, H-13213, H-15213, H-16567, H-22092, H-24282, H-24944, H-25750, H-26800, H-28409, H-30368, H-32673, H-38404, H-43492, H-43622, H-45467, H-47806, H-52651, H-60560, H-60961, H-62597, K-47672, L-20273

CALCIUM SULFATES A-12095, B-36716, B-62786, C-33632

CALIBRATION METHODS C-00941, C-01593, C-06352, C-06398, C-07710, C-07860, C-08077, C-11041, C-11691, C-11779, C-12760, C-23546, C-23547, C-23657, C-24331, C-26692, C-28530, C-30007, C-32966, C-37799, C-40138, C-40422, C-43570, C-43979, C-44933, C-46784, C-48392, C-53625, C-58842, C-69526, C-69675, C-71044, C-74346, C-79389, D-29040, D-49260, F-52013, H-19703, H-42946

CALIFORNIA A-00375, A-09785, A-33853, A-47143, A-67806, B-04853, D-26702, E-29774, E-33092, G-28199, H-00301, H-01809, H-03613, H-03616, H-03629, H-03766, H-05342, H-06459, H-07255, H-11407, H-16244, H-16896, H-20573, H-27030, H-33089, H-33127, H-33468, H-68394, I-00695, J-43002, K-03582, K-11414, K-27010, K-38197, L-09677, L-17614, L-32173, L-32245, L-32272, L-44054, N-04212, N-28923, N-63463

CAMERAS E-04987

CANADA A-08882, A-20134, A-34018, A-35985, A-39587, B-16962, B-42458, B-44638, B-49031, C-00264, C-00626, C-00636, C-00941, C-01313, C-01349, C-03478, C-03503, C-04405, C-12100, C-18344, C-23767, C-24018, C-24331, C-40211, C-43672, C-44285, C-57781, D-01872, D-37473, D-42760, D-49860, E-29315, E-78933, F-80516, F-81069, G-01047, G-01096, G-01426, G-02539, G-04145, G-07961, G-16874, G-19055, G-28037, G-37791, G-48697, G-66044, G-67325, H-00265, H-00631, H-00788, H-00920, H-01664, H-02200, H-02379, H-03549, H-03571, H-03729, H-08884, H-09553, H-12045, H-25499, H-32736, H-36883, H-39098, H-48403, H-51109, H-56788, H-60690, H-67056, H-70752, I-00695, J-76213, K-68582, L-17614, L-20273, L-47380, L-84415, N-52010
CANCER A-00375, A-22973, A-45145, B-19177, G-05833, G-07961, G-11942, G-16345, G-18987, G-22628, G-27379, G-37791, G-39494, G-41706, G-48693, G-48697, G-66044, G-73658, G-74290, H-35877, H-42857, N-49170
CAPITAL B-80213, B-81040, J-76213
CARBIDES A-30517, A-33853, A-42680, A-43272, A-81169, B-60864, C-44253
CARBON A-18449, A-22875, A-32702, A-39460, A-45858, A-49617, B-12288, B-12465, B-30276, B-32963, B-35106, B-35513, B-36532, B-37536, B-41839, B-42078, B-43863, B-44793, B-45707, B-49023, B-50652, B-68201, B-71796, B-72656, C-06983, C-41064, C-45344, D-52578, G-52638, H-10150, K-10168
CARBON BLACK A-18449, A-22875, A-32702, A-39460, A 45858, A-49617, B-12465, B-32963, B-35106, B-35513, B-36532, B-37536, B-42078, B-43863, B-44793, B-45707, B-49023, B-71796, C-41064, C-45344, D-52578, H-10150, K-10168
CARBON DIOXIDE A-00220, A-00375, A-00896, A-09214, A-09321, A-09332, A-09697, A-11541, A-11590, A-12587, A-12773, A-12889, A-15452, A-17357, A-23865, A-24370, A-28038, A-29786, A-31315, A-32060, A-34018, A-36045, A-36377, A-40344, A-40471, A-40600, A-44566, A-45145, A-65064, A-71477, A-75089, B-07664, B-16962, B-35513, B-42083, B-43299, B-45468, B-47677, B-48480, B-49031, B-59230, B-70840, B-79711, C-06112, C-06962, C-17128, C-20540, C-20650, C-22812, C-22877, C-24970, C-26203, C-30840, C-32534, C-35108, C-39719, C-41719, C-43672, C-44238, C-44933, C-46034, C-47218, C-49879, C-50337, C-60553, C-61103, C-65118, C-65846, C-66606, C-66753, C-69152, C-74346, C-79835, D-18537, D-19966, D-22348, D-23845, D-33425, D-44799, E-29774, E-72995, F-16218, F-21632, F-39861, F-57580, F-57581, F-62189, F-68048, F-81069, G-18785, G-24153, G-26743, G-39494, G-44867, G-48068, G-79848, G-80197, G-84137, G-84260, H-02379, H-02382, H-03570, H-03572, H-05399, H-05421, H-06459, H-10150, H-11100, H-35964, H-45467, H-49647, H-56204, I-07553, I-24308, I-27060, I-46606, I-54961, L-09677, L-25542, L-29818, L-32173, L-32245, L-32272, L-40889, N-04212, N-20495, N-44066, N-46820, N-51942, N-66750
CARBON DISULFIDE A-49924, B-15322, B-30519, B-41378, B-42078, B-43299, B-45707, C-09983, C-20030, C-20595, C-42926, C-43985, C-48392, C-65118, C-83592, F-16218, G-02539, G-71536, G-84260, H-39537, I-23108, K-28466, L-17188, L-29504, L-44054
CARBON MONOXIDE A-00220, A-00375, A-00896, A-01687, A-08486, A-08882, A-09697, A-09785, A-11590, A-12587, A-12773, A-12889, A-15452, A-17344, A-17357, A-20134, A-22973, A-23561, A-27617, A-28038, A-29532, A-29786, A-31315, A-32060, A-32519, A-32855, A-33853, A-34018, A-36045, A-36377, A-37996, A-39460, A-40159, A-40180, A-40344, A-40401, A-41877, A-42675, A-42676, A-42682, A-42751, A-43270, A-43272, A-44566, A-45145, A-46925, A-47048, A-47143, A-47954, A-47962, A-47963, A-47966, A-48116, A-48231, A-48849, A-48946, A-49617, A-49924, A-51100, A-52912, A-59494, A-60281, A-60728, A-60827, A-60866, A-61007, A-61154, A-61570, A-65064, A-67806, A-69309, A-69422, A-71477, A-76122, A-76274, A-80334, A-81169, A-81861, A-82192, B-02541, B-07549, B-07664, B-16962, B-26911, B-28502, B-29680, B-30519, B-32190, B-35513, B-38115, B-42083, B-42172, B-43299, B-44979, B-45380, B-45468, B-47731, B-48480, B-49031, B-62165, B-70659, B-70840, B-71796, B-71841, B-75138, B-75204, B-76008, B-79711, B-81256, B-84391, C-02681, C-03119, C-03527, C-06112, C-09983, C-11574, C-15171, C-17128, C-22517, C-22812, C-22877, C-24603, C-26707, C-27248, C-27294, C-30840, C-31115, C-32534, C-35108, C-35441, C-35737, C-35956, C-39022, C-39719, C-41719, C-41763, C-42926, C-42928, C-43672, C-43979, C-43985, C-43986, C-44253, C-45760, C-46034, C-47218, C-48392, C-49752, C-49879, C-49992, C-50337, C-51762, C-52992, C-56572, C-56681, C-58278, C-59814, C-61103, C-61851, C-63848, C-65118, C-65846, C-66606, C-66753, C-68944, C-69152, C-69174, C-70686, C-71044, C-74346, C-74471, C-75058, C-79842, C-80103, C-83495, C-83592, C-84660, D-18537, D-22348, D-23845, D-25593, D-26086, D-26702, D-27254, D-31396, D-33425, D-33576, D-35764, D-40896, D-41979, D-44799, D-49860, D-50307, D-73286, D-73835, D-78193, D-78442, E-29774, E-79132, F-02337, F-16218, F-25636, F-39861, F-62189, F-68048, G-01794, G-02539, G-05833, G-07098, G-11942, G-16345, G-16916, G-18785, G-18987, G-19148, G-24153, G-24580, G-26274, G-27379, G-31319, G-32607, G-38616, G-38721, G-39494, G-41036, G-41706, G-43323, G-46085, G-48068, G-49756, G-50161, G-50916, G-55517, G-57299, G-60625, G-61146, G-61467, G-66044, G-68583, G-71484, G-71536, G-71948, G-73658, G-74290, G-74580, G-78873, G-79848, G-80197, G-80857, G-84137, G-84260, H-00301, H-03116, H-04984, H-05421, H-11100, H-20158, H-23188, H-23295, H-26491, H-31527, H-39537, H-40202, H-47014, H-49779, H-51526, H-51953, H-52928, H-66715, H-73510, I-24308, J-30696, J-41121, J-42746, K-08420, K-11414, K-14772, K-19750, K-19818, K-27010, K-28466, K-31968, K-36823, K-37472, K-41682, K-44377, K-46081, K-47672, K-51229, K-58638, K-58899, K-60180, K-68582, K-69550, K-71991, K-72145, K-80854, L-06349, L-06734, L-17472, L-24122, L-25427, L-25542, L-29504, L-29598, L-29818, L-32245, L-32789, L-33495, L-37943, L-40461, L-40889, L-41455, L-42188, L-42873, L-44054, L-47380, L-48719, L-60630, L-73839, L-76397, L-76847, L-77234, L-80894, L-81220, L-84415, N-04212, N-20495, N-21287, N-44066, N-46820, N-49170, N-50748, N-50867, N-63463, N-64545, N-66750
CARBON TETRACHLORIDE G-68583, K-51057
CARBONATES A-34096, A-49852, B-12465, B-30276, B-59861, B-61954, C-12100, C-12593, C-38741, C-60278, G-04145, H-04997, H-16567, I-07553, K-51057
CARBONYLS A-46925, B-30519, B-43299, B-62165, B-75204, C-35737, C-39719, C-61993, C-65118, C-79389, G-48068, G-84260, K-51057, L-09677, L-29504
CARBOXYHEMOGLOBIN G-11942, G-31319, G-48068, G-49756, G-60625, G-71948, K-08420, K-36823
CARBURETION B-02541
CARBURETOR EVAPORATION LOSSES L-09677
CARCINOGENS A-00640, A-01125, A-39460, A-45145, A-47048, C-00264, C-00626, C-00941, C-01349, C-01593, C-02042, C-02565, C-02681, C-03119, C-03527, C-03550, C-04405, C-67116, D-01872, D-19145, D-34008, E-02325, G-01047, G-01096, G-01674, G-07961, G-18987, G-28199, G-34398, G-38616, G-48693, G-49756, G-52029, G-71484, G-73658, G-79848, H-00187, H-00240, H-00265, H-00266, H-00301, H-00631, H-00633, H-00944, H-00964, H-01506, H-01664, H-03860, H-03873, K-03582, N-66750
CARDIOVASCULAR DISEASES A-00375, A-27595, D-31396, G-00165, G-02539, G-18785, G-18987, G-23711, G-36723, G-40597, G-48637, G-74290, H-08884
CASCADE IMPACTORS A-42731, B-47466, C-35956, C-47218
CATALYSIS A-01125, A-22875, B-07549, B-12465, B-18826, B-26908, B-31889, B-38299, B-45846, B-60282, B-60864, B-63474, C-04692, C-27769, C-41064, C-83495, G-01728, H-08513
CATALYSTS A-22875, B-07549, B-12465, B-18826, B-31889, B-38299, B-45846, C-04692, C-27769, C-41064, G-01728, H-08513
CATALYTIC ACTIVITY B-26908, B-38299, B-60282, B-60864, B-63474, H-08513
CATALYTIC AFTERBURNERS A-47963, B-07549, B-28502, B-35111, B-45846, B-69131, B-70840, B-76512, L-77234
CATALYTIC OXIDATION A-01125, A-22875, A-34334, A-63661, B-15322, B-35111, B-41378, B-42078, B-45707, B-45846, B-47680, B-54799, B-60282, B-62165, B-63474, B-69965
CATS G-03394, G-30145, H-04544, H-42857

CATTLE A-00375, A-02312, A-13699, A-22973, A-26258, A-28282, A-31935, A-32576, A-71273, B-06587, B-09664, B-25433, C-00126, C-01793, C-20701, C-60410, D-33309, G-03394, G-04983, G-11444, G-11467, G-12547, G-12550, G-15040, G-35569, G-38616, G-43896, G-44593, G-47807, G-49448, G-50161, G-81250, G-84266, H-00600, H-00944, H-01092, H-04544, H-04848, H-04850, H-04917, H-04918, H-04919, H-04923, H-04924, H-04925, H-04997, H-05004, H-05421, H-05612, H-06353, H-06354, H-09533, H-10711, H-11452, H-11456, H-11466, H-11469, H-12529, H-12533, H-12538, H-12554, H-13159, H-13203, H-13213, H-13985, H-18268, H-18269, H-18270, H-18271, H-20015, H-20707, H-22887, H-23624, H-24944, H-25665, H-25735, H-25945, H-26718, H-26734, H-26742, H-26795, H-27907, H-27923, H-28031, H-28035, H-28679, H-28830, H-29206, H-29277, H-29736, H-29991, H-30297, H-31208, H-32291, H-32588, H-32736, H-33290, H-35877, H-35992, H-37346, H-37480, H-38407, H-38417, H-39493, H-39607, H-39627, H-39895, H-39923, H-40201, H-40599, H-40916, H-41439, H-42857, H-43226, H-44295, H-45781, H-46997, H-47286, H-48167, H-48193, H-48639, H-49316, H-49434, H-49561, H-52964, H-59935, H-61000, H-61496, H-64427, H-65103, H-66035, H-66715, H-67453, H-68770, H-76901, J-28805, K-03582, K-31968, L-24010, L-25642, N-12307, N-28923

CEDAR TREES H-79309

CELL GROWTH G-30183, G-31319, G-32596, G-50414, G-56959, G-74821, H-10841, H-38332, H-56521

CELL METABOLISM G-43277, G-84260, H-08884, H-10150, H-16399, H-21500, H-28437, H-38407, H-38568, H-39363, H-45557, H-62548, H-62597, H-64427, H-68575

CELL WALLS G-50197

CELLS (BIOLOGY) A-06241, C-03478, D-34008, G-03246, G-04734, G-10203, G-11000, G-13215, G-13700, G-14112, G-19880, G-24392, G-25160, G-28754, G-30385, G-32596, G-33872, G-37240, G-37569, G-40920, G-41685, G-41687, G-41688, G-43277, G-44594, G-54968, H-00265, H-00654, H-00737, H-03729, H-03860, H-05004, H-05585, H-06681, H-13203, H-13247, H-16900, H-19703, H-19863, H-22284, H-26734, H-28437, H-29010, H-38332, H-39627, H-39902, H-45022, H-45160, H-46338, H-56625, H-64588, H-66715, H-79633

CEMENT PLANTS (HYDRAULIC) A-81745, D-83399, H-80575

CEMENTS A-09541, A-23865, A-32702, A-34018, A-36377, A-37752, A-38657, A-42677, A-43272, A-47965, A-49924, A-60729, A-67940, A-68703, B-19177, B-19210, B-43863, C-26729, C-46443, C-49391, D-41979, D-47982, D-49860, G-24392, H-11157, H-36998, H-38017, H-40201, H-43492, H-45160, H-56655, H-80575, J-30696, J-39910, J-48171, L-25642, L-37747, L-39749, L-40461, L-48788, N-21287

CENTRAL AMERICA A-43403

CENTRIFUGAL SEPARATORS A-02847, A-04068, A-05140, A-05601, A-09214, A-09696, A-09799, A-12692, A-17883, A-29519, A-40159, A-40180, A-42751, A-43270, A-43272, A-46119, A-47963, A-48429, A-60827, A-71262, A-74262, A-82192, B-06587, B-16699, B-19177, B-22484, B-22853, B-23182, B-23370, B-25433, B-28502, B-29403, B-29680, B-29725, B-30519, B-31567, B-32231, B-32384, B-32461, B-35106, B-35111, B-35513, B-36716, B-38082, B-38593, B-42104, B-43299, B-44343, B-44838, B-44979, B-45078, B-45380, B-47821, B-48143, B-48814, B-49023, B-49031, B-52838, B-58993, B-59230, B-60849, B-63474, B-63784, B-64898, B-66947, B-67742, B-70428, B-70537, B-70840, B-71796, B-76232, B-82918, C-23575, C-27044, C-33956, D-32679, F-44721, K-33107, K-78880, L-32884

CERAMICS A-02653, A-28652, A-30296, A-31134, A-37190, A-43272, A-47965, A-52277, A-52664, A-58334, A-58370, A-58402, A-66977, A-76644, B-06587, B-19177, B-30814, B-45078, B-48879, B-51845, B-53868, B-63775, C-61896, G-26846, H-20707, H-29443, H-29597, H-38568, H-39537, H-65715, L-37747, L-39749

CERIUM COMPOUNDS C-24456, C-24546, E-43424, G-10247

CESIUM COMPOUNDS F-04468

CHAMBER PROCESS B-36716

CHARCOAL B-12288, B-30276, B-41839, B-50652, B-68201, B-72656, C-06983, G-52638

CHEMICAL BONDS B-71297, C-26729, F-13565, F-81496, G-52638, G-80197, H-02382

CHEMICAL COMPOSITION A-08882, A-09541, A-28282, A-42731, A-49617, A-50013, A-52741, A-53295, A-57231, A-59257, A-60728, A-64926, A-72133, A-73078, A-74262, A-75077, A-76638, A-79567, A-79774, A-80994, A-81169, A-81343, A-82269, B-07549, B-32627, B-43531, B-70428, C-02681, C-03503, C-10966, C-11574, C-20595, C-23096, C-24886, C-39136, C-43981, C-46443, C-49752, C-53625, C-68559, C-75339, C-77492, C-80103, D-10619, D-17102, D-23845, D-33017, D-43317, D-49260, D-50307, D-51929, D-52575, D-52578, D-55187, D-58218, D-62438, D-63186, D-69144, D-71348, D-71362, D-73286, F-14907, G-04983, G-19148, G-48697, H-13804, H-39159, H-45663, H-48374, H-61496, H-77391, I-08076, K-69550

CHEMICAL CONDENSATION N-66750

CHEMICAL METHODS A-09541, A-31529, A-40471, A-40600, A-42731, A-61564, A-74512, A-75077, B-29680, C-00450, C-02042, C-02565, C-02681, C-03503, C-03550, C-04463, C-04685, C-04686, C-04687, C-04689, C-04690, C-04691, C-04692, C-04757, C-05439, C-05620, C-06279, C-06983, C-07710, C-07860, C-07871, C-08077, C-09983, C-11574, C-12334, C-12760, C-15171, C-15355, C-16801, C-16969, C-17092, C-17128, C-18016, C-18230, C-18264, C-18344, C-20595, C-20892, C-20895, C-21156, C-22812, C-23517, C-24331, C-24603, C-24970, C-25210, C-25806, C-26122, C-26400, C-26707, C-26744, C-27248, C-27341, C-27769, C-27962, C-28374, C-28441, C-28462, C-28671, C-28843, C-29198, C-29467, C-29887, C-30014, C-30793, C-31115, C-31712, C-32476, C-32534, C-33632, C-33929, C-35737, C-35956, C-36002, C-36800, C-37350, C-37463, C-37515, C-37579, C-37799, C-38741, C-39008, C-39022, C-39243, C-39719, C-39762, C-41064, C-41491, C-43570, C-43979, C-43985, C-43986, C-44177, C-44238, C-44253, C-44933, C-46034, C-47218, C-48916, C-49509, C-49752, C-49992, C-50093, C-50470, C-50936, C-51599, C-51762, C-52629, C-53523, C-53625, C-53876, C-53987, C-55923, C-56681, C-57781, C-58278, C-58842, C-59049, C-60419, C-60951, C-61896, C-61957, C-61995, C-63848, C-64779, C-64914, C-66753, C-67116, C-68229, C-69174, C-69675, C-69765, C-70638, C-71232, C-71245, C-73349, C-74221, C-74346, C-74354, C-74942, C-75339, C-77427, C-79389, C-80935, C-82650, C-83495, D-28097, D-39182, D-49260, D-52578, D-61140, E-04987, E-43424, F-02517, F-34948, G-08030, G-09575, G-26274, G-71324, G-74380, H-00964, H-03873, H-08513, H-18226, H-18265, H-18269, H-18319, H-28477, H-32897, H-36742, H-39328, H-42946, H-45474, H-50729, H-52994, H-54066, K-08420

CHEMICAL PROCESSES A-00340, A-00896, A-01125, A-02019, A-02312, A-02847, A-02988, A-03129, A-03565, A-04068, A-05040, A-05090, A-05587, A-05871, A-08116, A-08486, A-09321, A-09332, A-09651, A-09692, A-09693, A-09785, A-12741, A-12747, A-12749, A-12750, A-12809, A-12813, A-12822, A-12828, A-12884, A-12886, A-12888, A-12919, A-12929, A-12931, A-12933, A-13242, A-13699, A-15452, A-17076, A-17344, A-17464, A-21380, A-22547, A-22973, A-23865, A-24370, A-25305, A-26254, A-26329, A-29786, A-30296, A-30447, A-30517, A-32139, A-33735, A-35985, A-36377, A-37190, A-38657, A-39460, A-40159, A-40344, A-40401, A-42675, A-42680, A-42680, A-45858, A-46119, A-46558, A-47143, A-47954, A-47963, A-49924, A-55601, A-60728, A-61570, A-63661, A-65064, A-66977, A-67940, A-74154, A-75146, B-04794, B-07190, B-07549, B-15322, B-15813, B-19212, B-20857, B-22943, B-23310, B-24033, B-24033, B-26244, B-26279, B-26401, B-26908, B-28783, B-31708, B-32232, B-32461, B-32461, B-33918, B-35111, B-35111, B-36716, B-38445, B-38593, B-40251, B-41378, B-44793, B-45078, B-45544, B-45707, B-45757, B-45846, B-47054, B-47680, B-47731, B-49031, B-50652, B-51845, B-54799, B-60864, B-67846, B-69131, B-70840, B-71623, C-00450, C-02042, C-16109, C-28530, C-30793, C-33632, C-35956, C-40211, C-47096, C-48492, C-49391, D-01872, D-09590, D-09658, D-27254, D-31371, D-32666, D-33108, D-37994, D-40896, D-49860, D-56463, D-56464, D-56465, E-14897, E-37013, E-49185, G-06485, G-07098, G-11467, G-29043, G-32152, G-32607, G-36751, G-44867, G-49164, G-50161, G-50371, G-70519, H-03766, H-11456, H-12533, H-12552, H-15501, H-18268, H-19656, H-20707, H-22930, H-23624, H-23661, H-25366,

H-25750, H-26978, H-27021, H-28647, H-30368, H-31733, H-32286, H-32289, H-32672, H-32673, H-37346, H-38412, H-38568, H-38574, H-39537, H-39895, H-40472, H-41439, H-45130, H-45781, H-46997, H-48167, H-48377, H-51484, H-68770, I-07553, I-23108, I-39031, J-29923, J-38409, J-39910, J-41121, J-48171, K-10168, K-37472, K-51212, K-58899, L-20273, L-37747, L-39749, L-45783, L-47380, L-48788, N-21287, N-37027

CHEMICALS AND ALLIED MANUFACTURING A-00896, A-05139, A-05140, A-09690, A-09695, A-09696, A-13353, A-13699, A-17344, A-17357, A-22547, A-25305, A-26136, A-26258, A-26329, A-28282, A-31935, A-32139, A-32855, A-33735, A-34018, A-35592, A-35985, A-39460, A-40344, A-43270, A-43816, A-44681, A-45858, A-46119, A-47954, A-47963, A-48429, A-55601, A-60281, A-60283, A-63661, A-67748, A-70069, A-70727, A-76411, A-76459, A-77993, A-79280, A-79511, A-81916, A-81917, A-82269, A-82353, A-82944, A-84479, B-15813, B-17485, B-18536, B-19210, B-20436, B-21034, B-22598, B-22913, B-24117, B-24355, B-25038, B-26674, B-27569, B-27835, B-28034, B-32231, B-32232, B-32384, B-36405, B-36475, B-36716, B-37080, B-37115, B-37603, B-37745, B-37914, B-38587, B-39104, B-40251, B-43533, B-43863, B-43972, B-44793, B-44979, B-45004, B-45254, B-45707, B-46086, B-47095, B-48143, B-51720, B-53603, B-58466, B-58632, B-59679, B-60282, B-63474, B-64092, B-65923, B-67136, B-67137, B-67742, B-70840, B-71472, B-80863, B-81040, B-81772, B-81773, B-81944, B-84418, C-14288, C-18230, C-20701, C-28530, C-36693, C-40211, C-61896, C-80935, D-24801, D-28188, D-33108, D-47982, D-48791, D-49260, D-49860, D-71272, E-29315, E-37037, F-15927, G-15555, G-16874, G-25469, G-26846, G-33510, G-33511, G-39219, G-79634, G-83798, H-15838, H-18226, H-19656, H-20707, H-23661, H-24395, H-25499, H-27021, H-28446, H-28830, H-28899, H-30301, H-32291, H-32588, H-32897, H-33290, H-33906, H-36787, H-38017, H-38404, H-38417, H-38574, H-39537, H-39627, H-39923, H-40201, H-45007, H-45130, H-46217, H-47385, H-49561, H-49647, H-53370, H-54066, H-55066, H-56874, H-58941, H-59935, H-65715, H-70752, H-74624, H-77050, H-79635, H-80064, H-81288, H-81771, I-39031, J-28805, J-30226, K-66916, L-37747, L-48788, L-84415

CHEMILUMINESCENCE METHODS C-80573, C-83495

CHEMISTS B-51845

CHIBA PREFECTURE D-47976, H-58941

CHICAGO A-00896, D-24736, D-33080, D-52578, L-09677

CHLORATES C-04692, F-34948

CHLORIDES A-09785, A-09799, A-15452, A-17344, A-17464, A-28038, A-29786, A-37562, A-37752, A-40344, A-42676, A-47048, A-50938, A-50961, A-53751, A-54622, A-58402, A-58939, A-60421, A-60728, A-60866, A-75089, A-77522, B-12465, B-14692, B-18826, B-24033, B-28786, B-32461, B-33554, B-36475, B-41418, B-44638, B-47054, B-47256, B-49023, B-50435, B-55180, B-58879, B-61954, B-62165, B-64070, B-81645, C-00126, C-04463, C-05078, C-06338, C-09770, C-12593, C-17092, C-18344, C-22458, C-23096, C-23162, C-23657, C-24022, C-24050, C-24124, C-24359, C-26485, C-26707, C-26981, C-27294, C-31115, C-35108, C-38280, C-38670, C-39762, C-43234, C-43985, C-47218, C-48674, C-48916, C-50876, C-60419, C-61103, C-61993, C-65118, C-70686, C-74942, C-79032, C-82650, D-21419, D-23845, D-23862, D-33108, D-37607, D-43170, D-44799, D-50690, D-51929, D-60574, D-63186, D-66083, D-78442, E-44030, F-04674, G-05504, G-10362, G-11000, G-18785, G-24153, G-43323, G-48068, G-80197, H-00301, H-03395, H-03860, H-06342, H-06395, H-16150, H-22092, H-24395, H-25499, H-25865, H-39098, H-39537, H-45007, H-45130, H-49779, H-54297, H-59028, H-60913, H-62548, H-63626, H-65928, H-76838, H-77325, H-78580, H-80536, H-82520, H-84557, I-23108, I-40833, I-52320, I-58585, I-69995, I-73616, K-34063, L-29504, L-32789, L-35795, L-40461

CHLORINATED HYDROCARBONS A-09785, A-27930, A-34334, A-37562, A-39460, A-47048, A-49738, A-50938, A-50961, A-60727, B-35111, B-45707, B-49929, B-59230, B-61259, C-17092, C-20030, C-27769, C-31712, C-36125, C-39136, C-39871, C-40422, C-79842, C-79843, C-83592, D-17102, E-44030, F-01677, F-03062, F-68048, G-01426, G-50916, G-52029, G-57701, G-68583, G-71536, G-71948, G-72961, G-79848, G-80197, G-84137, H-20158, H-42857, I-69995, K-10168, K-41682, K-44310, K-51057, L-17188

CHLORINE A-01125, A-03129, A-09785, A-17344, A-22875, A-27617, A-30517, A-31315, A-34018, A-36045, A-36377, A-37721, A-39460, A-40344, A-45858, A-47963, A-48946, A-55601, A-58402, A-60421, A-64926, A-79567, A-80238, A-80994, A-81745, B-07815, B-08344, B-12465, B-24033, B-29403, B-29725, B-35106, B-35111, B-36552, B-37809, B-37914, B-38504, B-41378, B-47054, B-47256, B-47680, B-48480, B-50868, B-60075, B-62165, B-70658, B-76512, B-77475, B-80950, B-81256, B-83613, B-84391, B-84418, C-05078, C-05586, C-06352, C-09983, C-17128, C-18696, C-22812, C-22877, C-24970, C-28126, C-30840, C-31115, C-35737, C-38670, C-41719, C-42928, C-44238, C-44253, C-44285, C-45760, C-46034, C-46303, C-47096, C-48392, C-48492, C-49509, C-49992, C-50470, C-50876, C-51762, C-59513, C-59814, C-60419, C-61103, C-61851, C-61993, C-66606, C-66753, C-69174, C-70686, C-72017, C-74221, C-74346, C-79003, C-79032, C-80227, C-80259, C-83442, D-17102, D-18537, D-21419, D-22348, D-23862, D-25593, D-31371, D-33108, D-40896, E-30126, E-43424, E-79132, F-03062, F-13565, F-78035, G-34398, G-38616, G-43323, G-48068, G-79848, H-00301, H-01800, H-03395, H-04984, H-08884, H-12042, H-13474, H-16385, H-17710, H-21189, H-23188, H-24035, H-28474, H-28475, H-28477, H-30368, H-30473, H-31527, H-32714, H-32982, H-35613, H-35964, H-36159, H-36742, H-39328, H-40202, H-41362, H-41699, H-41983, H-42086, H-43492, H-45022, H-45467, H-45474, H-45776, H-47014, H-48639, H-49644, H-49778, H-49779, H-50677, H-50780, H-51953, H-52102, H-62548, H-65394, H-67026, H-67056, H-67304, H-67348, H-67457, H-70776, H-71931, H-76451, H-76838, H-78580, H-84484, H-84557, I-00695, I-23108, I-40510, I-58585, J-38409, K-10168, K-27010, K-28466, K-31968, K-33107, K-34063, K-42039, K-44377, K-68582, K-72151, K-80854, L-19434, L-25542, L-29818, L-30620, L-32884, L-35795, L-38669, L-41455, L-42021, L-42188, L-44054, L-76965, L-82278, N-50748, N-66750

CHLORINE COMPOUNDS A-09785, A-09799, A-15452, A-17344, A-17464, A-28038, A-29786, A-32519, A-36045, A-37562, A-37721, A-37752, A-40344, A-42675, A-42676, A-42677, A-42682, A-43403, A-47048, A-47966, A-50938, A-50961, A-51100, A-52741, A-53751, A-54622, A-55601, A-58402, A-58939, A-60421, A-60728, A-60827, A-60866, A-69353, A-75089, A-77522, B-08344, B-12465, B-14692, B-18826, B-24033, B-28786, B-29403, B-32190, B-32461, B-33554, B-35106, B-36475, B-38115, B-41418, B-41569, B-44638, B-45380, B-47054, B-47256, B-47341, B-47680, B-49023, B-49929, B-50435, B-50868, B-55180, B-58879, B-61954, B-62165, B-64070, B-81645, C-00126, C-04405, C-04463, C-04692, C-05078, C-06279, C-06338, C-09770, C-12593, C-17092, C-18344, C-20030, C-20595, C-22458, C-23096, C-23162, C-23657, C-24018, C-24022, C-24050, C-24124, C-24359, C-26121, C-26122, C-26485, C-26707, C-26981, C-27294, C-28126, C-31115, C-32476, C-35108, C-35737, C-35956, C-38280, C-38670, C-39136, C-39719, C-39762, C-41719, C-43234, C-43979, C-43981, C-43985, C-44034, C-47218, C-48492, C-48674, C-48916, C-50876, C-51762, C-52629, C-59513, C-60419, C-61103, C-61993, C-64779, C-65118, C-65846, C-66753, C-70686, C-74346, C-74942, C-79032, C-82650, D-21419, D-23845, D-23862, D-27254, D-33017, D-33108, D-37607, D-37994, D-40896, D-43170, D-44799, D-50690, D-51929, D-52578, D-60574, D-63186, D-66083, D-78442, E-40271, E-44030, E-72995, F-01677, F-04674, F-16218, F-34948, G-05504, G-10362, G-11000, G-18785, G-24153, G-30841, G-43323, G-48068, G-79848, G-80197, H-00301, H-03395, H-03860, H-06342, H-06395, H-12155, H-16150, H-20158, H-22092, H-24395, H-25499, H-25865, H-35613, H-36159, H-39098, H-39537, H-40368, H-41189, H-42086, H-42923, H-45007, H-45130, H-49644, H-49779, H-50780, H-51109, H-51526, H-52102, H-54297, H-56204, H-57475, H-59028, H-60913, H-62548, H-63626, H-65928, H-76838, H-77325, H-78580, H-79976, H-80536, H-82520, H-83145, H-84557, H-84651, I-23108, I-40833, I-52320, I-54961, I-58585, I-63871, I-69995, I-73616, K-11414,

K-19818, K-34063, K-36823, K-38197, K-41682, K-51057, L-27677, L-28349, L-29504, L-32789, L-35795, L-38669, L-40461, L-48719, L-73839, N-21287, N-32254, N-64937
CHLOROFORM C-27769, G-72961, K-51057
CHLOROPLASTS C-24966, H-04683, H-05585, H-10342, H-21500, H-22284, H-23988, H-32854, H-35877, H-39098, H-39363, H-41362, H-41699, H-43663, H-44345, H-48403, H-56625, H-60913, H-62548, H-64824, H-67348, H-74626
CHLOROSIS A-31144, B-09664, G-01674, G-11444, H-00301, H-00633, H-01250, H-01506, H-01800, H-03395, H-04403, H-04678, H-04904, H-05667, H-08884, H-10342, H-10673, H-14247, H-14968, H-15213, H-16244, H-16399, H-16472, H-16896, H-17109, H-17705, H-17749, H-19656, H-21500, H-21687, H-26800, H-26861, H-28830, H-28899, H-29616, H-30298, H-31124, H-32771, H-33716, H-34121, H-35578, H-38568, H-39363, H-39986, H-41699, H-44345, H-48403, H-50415, H-51109, H-53370, H-53903, H-54597, H-54910, H-56625, H-57810, H-58941, H-59935, H-67347, H-76451, H-76715, H-78580, H-83797
CHROMATOGRAPHY A-22875, A-31529, A-48116, A-49738, B-14692, B-29680, B-44638, C-00126, C-00264, C-01313, C-01593, C-02681, C-06112, C-06338, C-06352, C-07719, C-07871, C-11574, C-15171, C-18696, C-20701, C-22877, C-23518, C-23546, C-25441, C-26122, C-26707, C-27248, C-27294, C-28126, C-29198, C-30014, C-32476, C-32534, C-35956, C-36125, C-38670, C-39288, C-39719, C-41020, C-41063, C-41719, C-42928, C-43979, C-46034, C-47218, C-48492, C-48916, C-49391, C-49752, C-49879, C-50936, C-51762, C-52629, C-55789, C-57079, C-58278, C-60010, C-60553, C-61859, C-67116, C-71044, C-74221, C-74346, C-79032, C-80495, C-80573, C-82650, C-83495, C-84209, D-31371, D-33080, E-33570, F-02517, G-01426, G-08031, H-00187, H-02382, H-02516, H-08513, H-12032, H-19703, H-21498, H-32854, H-42907, I-07553, I-24308, I-27060
CHROMIUM I-40510, I-40833, L-37747
CHROMIUM COMPOUNDS A-09785, A-27617, A-49617, A-51100, A-52741, A-57231, A-60729, A-74262, A-75077, A-76638, A-80238, A-81169, A-81343, A-81931, A-82279, B-36532, C-38280, C-38670, C-39136, C-39516, C-42928, C-43985, C-50936, C-53523, C-55789, C-61957, C-75339, C-82552, C-83442, D-17102, D-30058, D-50307, D-76890, G-34398, G-36723, G-39833, G-47807, G-52029, G-71933, G-80197, G-84137, H-13474, H-48374, I-07553, K-10168, K-41682, K-68224, K-74109
CHROMIUM OXIDES A-32855, E-33579, H-16385
CHROMOSOMES G-25160, G-30385, G-37240, G-54968, H-03729, H-06681, H-13247, H-16900, H-19863, H-29010
CHRYSANTHEMUM H-83721, H-83730
CILIA H-66715
CINCINNATI D-23845, D-24736, D-52578, G-28199, L-09677
CINDERS A-60727, L-20273
CIRCULATORY SYSTEM C-20701, G-01426, G-03246, G-04849, G-04983, G-06288, G-08030, G-10203, G-14319, G-23711, G-24494, G-25946, G-28754, G-33872, G-36723, G-36751, G-38106, G-40597, G-40635, G-48068, G-48637, G-49164, G-49448, G-52029, G-74823, G-79619, H-01092, H-04923, H-24944, H-42907, H-49434
CITIZENS GROUPS A-47143, B-09664, D-30705
CITRUS A-03450, A-12095, B-04853, B-09664, C-01349, C-05892, C-20540, D-28188, D-71272, E-37037, H-02379, H-03611, H-04403, H-04672, H-05667, H-06404, H-06459, H-07255, H-10342, H-11407, H-16896, H-17109, H-18770, H-20573, H-21093, H-23516, H-24358, H-27030, H-28830, H-28899, H-33468, H-35578, H-37403, H-44345, H-46051, H-53370, H-54910, H-59935, H-74721, H-77050, H-80085, H-82146, J-28805, J-43002, K-26738
CITY GOVERNMENTS A-03450, A-25305, A-32855, D-28097, L-29818, L-41455
CLAY A-02653, A-17377, A-33735, A-39460, A-39635, A-43272, B-45078, B-64428, D-25093, G-52638, H-24548, H-29597, J-39910
CLEAN AIR ACT A-00896, A-65064, C-46034, K-14772, K-47672, L-24122, N-20040
CLEANING B-80213
CLOUDS C-48392, H-48798
CLOVER D-58427, H-01800, H-11466, H-16222, H-26916, H-29277, H-30298, H-32280, H-44295, H-63442
COAL A-02988, A-04068, A-12557, A-17357, A-17377, A-22875, A-26136, A-29786, A-32060, A-32702, A-34018, A-34334, A-38657, A-39460, A-40344, A-40401, A-40471, A-42685, A-43272, A-45858, A-47188, A-47962, A-53751, A-57231, A-59257, A-61007, A-61154, A-66977, A-75077, A-76638, A-81343, B-02962, B-10618, B-32231, B-33554, B-35106, B-35111, B-36552, B-45078, B-47086, B-65638, B-77838, C-18264, C-22812, C-23096, C-44710, C-53523, C-64912, C-68559, C-75339, D-09590, D-22348, D-23862, D-27254, D-31396, D-33108, D-52811, E-59234, G-08201, G-16874, G-31234, G-32607, G-71933, G-73658, H-01398, H-17710, H-19656, H-38574, H-48374, H-66983, H-70487, I-07553, J-30696, K-34063, L-19434, L-60630, N-32254
COAL CONVERSION B-65638, B-67700, B-75204, F-44721
COAL PREPARATION A-57231, A-61154, B-60849, F-44721, H-39537
COATING, ENGRAVING AND ALLIED SERVICES A-09785, B-36532, B-66592, G-81181, I-39031, L-37747
COBALT COMPOUNDS A-52741, A-76638, A-81343, B-77838, C-82552, D-50307, E-29910, E-43424, G-36723, G-52029, G-68583, G-71933, H-11452, H-67348, I-40510, K-10168
CODES L-06939, L-19064
COFFEE ROASTING A-26254, A-43270
COKE A-00896, A-22875, A-38657, A-40159, A-41877, A-47962, A-49924, A-59775, B-02962, B-32231, B-38188, B-43840, D-33108, D-39182, D-39737, D-40896, G-32607, L-09677
COLLECTORS (MECHANICAL) A-02847, A-04068, A-05140, A-05601, A-08882, A-09214, A-09696, A-09799, A-12476, A-12692, A-15452, A-17883, A-29519, A-31935, A-40159, A-40180, A-40344, A-41877, A-42677, A-42683, A-42751, A-43270, A-43272, A-46119, A-47963, A-47965, A-48429, A-52912, A-60281, A-60827, A-61154, A-71262, A-74262, A-82192, B-02541, B-02962, B-06587, B-07664, B-08344, B-09902, B-10618, B-18698, B-18699, B-19177, B-22484, B-22853, B-22943, B-23182, B-23370, B-24116, B-25433, B-25658, B-28502, B-29403, B-29680, B-29725, B-30276, B-30519, B-31567, B-32231, B-32232, B-32384, B-32461, B-33620, B-35106, B-35111, B-35513, B-36405, B-36552, B-36716, B-36755, B-38082, B-38115, B-38593, B-40251, B-40381, B-40414, B-42104, B-42172, B-43299, B-44343, B-44793, B-44338, B-44979, B-45004, B-45078, B-45380, B-45544, B-47677, B-47680, B-47821, B-48143, B-48814, B-49023, B-49031, B-50868, B-52179, B-52838, B-53867, B-53868, B-53875, B-58993, B-59230, B-60255, B-60282, B-60849, B-63474, B-63784, B-64898, B-66947, B-67742, B-70428, B-70537, B-70840, B-71796, B-71841, B-76232, B-82032, B-82918, B-83198, C-23575, C-27044, C-33711, C-35956, C-71245, C-72015, D-32679, F-44721, J-29923, J-48171, K-31968, K-33107, K-78880, L-17472, L-29598, L-32884, N-46820, N-64937
COLOR H-78580
COLORADO C-44710, D-24736, D-52578, K-27010
COLORIMETRY A-40471, A-42731, A-48116, A-59257, A-61564, B-29680, B-37164, C-00126, C-00260, C-00626, C-02565, C-02681, C-03503, C-03550, C-03908, C-04105, C-04458, C-04463, C-04687, C-04689, C-04690, C-05078, C-05620, C-06112, C-07719, C-07871, C-09983, C-11574, C-11678, C-12451, C-12760, C-13056, C-15171, C-16801, C-16969, C-18016, C-18230, C-18264, C-19076, C-20540, C-20595, C-21730, C-21855, C-22458, C-22812, C-22877, C-22879, C-23096, C-23162, C-23286, C-23546, C-23547, C-23569, C-23767, C-23947, C-24008, C-24118, C-24222, C-24279, C-24310, C-24331, C-24359, C-24399, C-24456, C-24546, C-24603, C-24966, C-25487, C-25647, C-26121, C-26122, C-26203, C-26259, C-27248, C-27330, C-27933, C-28285, C-28441, C-28462, C-29198, C-29220, C-29467, C-30014, C-31115, C-32450, C-32476, C-32631, C-32643, C-34126, C-35956, C-36693, C-37799, C-38670, C-38917, C-39022, C-39719, C-40138, C-40211, C-40409, C-42928, C-43570, C-43979, C-43981, C-43985, C-43986, C-44596, C-45802, C-46034, C-46303, C-46443, C-46784, C-47096, C-47218, C-48392, C-48492, C-48916, C-49391, C-49509, C-49752, C-49992, C-50470, C-50936, C-51551, C-51762, C-52101, C-53876, C-56244, C-58278, C-61896, C-61993, C-66753, C-67116, C-71231, C-74221, C-74354, C-77492, C-79032, C-80423, C-83495, C-84499, D-19966, D-43317, D-48850, D-52578, E-04987, E-44277,

G-08030, G-08031, G-26873, G-27755, G-78873, H-00187, H-00964, H-03873, H-07255, H-17822, H-18319, H-28480, H-46719, H-48536, H-54066, H-54710, I-00695, K-08420, L-24481, N-14783
COLUMN CHROMATOGRAPHY B-29680, C-07871, C-23518, C-23546, C-26122, C-26707, C-48916, C-79032, C-84209, H-08513, H-21498, H-42907
COMBUSTION A-15452, A-23561, A-29532, A-48116, A-61800, A-72133, B-18699, B-29403, B-33554, B-49929, C-18016, C-23517, C-24603, C-24966, C-27341, C-31827, C-64912, C-83495, D-09590, D-52811, E-43855, F-44721, F-59528, G-24153, G-71933, H-54066, L-09677, N-20495
COMBUSTION AIR A-11590, A-33853, A-37562, A-46925, A-48231, A-49852, A-60866, A-64926, B-07664, B-18826, B-26911, B-33554, B-42172, B-59230, B-71796
COMBUSTION CHAMBERS B-77838
COMBUSTION PRODUCTS A-00375, A-00896, A-01125, A-01528, A-02653, A-02847, A-03565, A-04068, A-05139, A-05587, A-08102, A-08116, A-08748, A-08816, A-09214, A-09321, A-09332, A-09541, A-09651, A-09690, A-09692, A-09693, A-09694, A-09695, A-09696, A-09697, A-09785, A-09799, A-11341, A-11453, A-11590, A-11876, A-11877, A-12470, A-12474, A-12587, A-12622, A-12676, A-12692, A-12740, A-12747, A-12750, A-12773, A-12809, A-12822, A-12828, A-12884, A-12886, A-12888, A-12889, A-12919, A-12929, A-12931, A-12933, A-15452, A-17344, A-18323, A-22547, A-22875, A-23022, A-23561, A-24039, A-26329, A-28038, A-28652, A-29519, A-29532, A-30218, A-30447, A-30517, A-31144, A-31315, A-31529, A-32519, A-32702, A-33735, A-33853, A-34334, A-35985, A-36377, A-37190, A-37562, A-39635, A-40401, A-40471, A-42675, A-42676, A-42677, A-42680, A-42682, A-42683, A-43816, A-45858, A-46558, A-46925, A-47048, A-47143, A-47410, A-47945, A-47954, A-47962, A-47966, A-48116, A-48231, A-48572, A-48849, A-48946, A-49738, A-49852, A-49886, A-49924, A-50018, A-50381, A-50938, A-50961, A-51100, A-51102, A-52277, A-52508, A-52741, A-52912, A-53295, A-53751, A-53955, A-54622, A-55407, A-57231, A-58334, A-58402, A-58939, A-59257, A-59494, A-60421, A-60727, A-61007, A-61800, A-75077, B-04794, B-05567, B-07664, B-08344, B-10618, B-13676, B-14692, B-15322, B-16555, B-17463, B-17485, B-18641, B-18698, B-18699, B-18826, B-18830, B-19177, B-20436, B-21034, B-22040, B-22434, B-22590, B-22943, B-23182, B-24033, B-24110, B-24333, B-24355, B-24834, B-25195, B-25433, B-25523, B-25658, B-26317, B-26401, B-27282, B-27569, B-28709, B-29403, B-29680, B-29725, B-30276, B-30519, B-30814, B-31567, B-31708, B-31889, B-32232, B-32384, B-32461, B-32627, B-32712, B-32963, B-33554, B-33918, B-35106, B-35111, B-36552, B-36716, B-37164, B-37402, B-37509, B-37544, B-37603, B-37809, B-38082, B-38115, B-38439, B-38476, B-38504, B-38587, B-38593, B-40251, B-40381, B-40712, B-42078, B-42083, B-42104, B-42172, B-42287, B-43481, B-43533, B-44121, B-44716, B-45078, B-45254, B-45757, B-45846, B-47054, B-47086, B-47095, B-47125, B-47186, B-47256, B-47341, B-47463, B-47466, B-47821, B-48143, B-48805, B-48811, B-48814, B-48879, B-49031, B-49420, B-49477, B-49979, B-50154, B-50652, B-50937, B-51101, B-51720, B-51755, B-51845, B-52179, B-52445, B-52838, B-52852, B-53620, B-53867, B-53868, B-54310, B-54799, B-55678, B-56057, B-56078, B-56528, B-56531, B-56591, B-58380, B-58466, B-58632, B-58879, B-58993, B-59230, B-59679, B-59845, B-59861, B-60075, B-60206, B-60255, B-75138, B-77838, C-03119, C-06112, C-06397, C-18230, C-22812, C-22877, C-23096, C-23575, C-25223, C-26713, C-27044, C-29737, C-29771, C-30793, C-30958, C-31115, C-32631, C-33632, C-35108, C-35737, C-35956, C-37463, C-37579, C-38670, C-39136, C-41624, C-43570, C-44238, C-48492, C-49391, C-49476, C-50876, C-52629, C-52992, C-53876, C-55367, C-55858, C-59049, C-59513, C-60278, C-71244, C-75339, C-80103, D-09590, D-23760, D-25093, D-26702, D-33309, D-33858, D-37502, D-41979, D-42760, D-49860, D-56463, E-14897, E-29774, E-33579, E-37639, E-44277, E-59075, E-59234, E-72995, F-04468, F-21632, F-44721, F-59528, F-62189, G-18785, G-31234, G-31319, G-32601, G-32607, G-33510, G-33511, G-38721, G-39219, G-40527, G-40597, G-40635, G-43323, G-44597, G-45683, G-73658, H-03116, H-08884, H-11452, H-17710, H-18226, H-21189, H-21422, H-23214, H-23295, H-23386, H-23950, H-24024, H-24064, H-24395, H-25865, H-26734, H-28647, H-29443, H-29597, H-29736, H-31733, H-32535, H-32539, H-32714, H-36787, H-37480, H-38017, H-38404, H-38412, H-38417, H-38574, H-39493, H-39537, H-39684, H-41370, H-41696, H-42857, H-43492, H-43622, H-44295, H-45160, H-46198, H-47385, H-48377, H-51109, H-51321, H-51470, H-56874, H-57475, H-58777, H-59327, H-59935, I-07553, I-23108, I-47291, I-58585, J-38409, J-39910, J-41121, K-34063, K-36823, K-37472, K-58899, L-09677, L-17188, L-19064, L-19434, L-20273, L-24481, L-29421, L-29598, L-30620, L-31492, L-32173, L-32245, L-32789, L-33722, L-38573, L-38669, L-39306, L-39749, L-42810, L-48719, L-59722, L-61705, L-76965, N-04212
COMMERCIAL EQUIPMENT A-00340, A-01125, C-61993, C-61995, C-74346, D-29040
COMMERCIAL FIRMS B-24033, B-28034, B-43840, B-45544, C-74346, I-00695, L-24481, L-29598, L-42188, L-43007
COMMON COLD G-06675
COMPLAINTS A-32855, D-47976, G-29043, G-49164, G-50371, L-06938, L-29598, L-37943
COMPOSTING A-50381, A-71615, B-24683, B-25038, B-44716
COMPRESSION B-65638, B-70840
COMPUTER PROGRAMS A-75146, C-44285, D-44799, E-02325, E-64013, H-06459, J-32706
COMPUTERS C-65846, C-66606, C-68944, E-29315, E-78793, F-21632, I-00695
CONCRETE A-43272, C-30432
CONDENSATION A-08882, A-12813, A-32060, A-44566, B-24110, B-33971, B-37745, B-70840, C-24603, C-35956
CONDENSATION (ATMOSPHERIC) A-00220, A-46119, A-79511, A-80507, C-48392, C-51599, D-23862, D-39737, D-40896, E-14897, G-12555, G-18987, G-32607, G-39219, G-40597, H-23295, H-25750, H-28149, H-46198, H-48798, H-51470, L-39306, N-04212, N-51942
CONDENSATION NUCLEI N-66750
CONDUCTIMETRIC METHODS C-05078, C-06112, C-14288, C-16109, C-25223, C-26122, C-26692, C-26981, C-28102, C-28671, C-29198, C-30007, C-31115, C-32534, C-35737, C-39022, C-40409, C-43570, C-43979, C-43985, C-43986, C-45344, C-46034, C-47218, C-48492, C-49509, C-49752, C-50470, C-51762, C-55858, C-58278, C-63848, C-74221, C-74942, C-83495, D-26026, D-37502, D-44267, D-48850, D-49118, E-04987, G-31234, H-06459, H-28149, L-17472
CONIFERS A-83543, C-66753, G-81181, G-81250, H-78058, H-78580, H-79309, H-79635, H-80189, H-80493, H-81771, H-82498, H-83082, H-84558, H-84579
CONSTRUCTION MATERIALS A-08816, A-09541, A-09785, A-23865, A-32702, A-33735, A-34018, A-34096, A-36212, A-36377, A-37752, A-38657, A-39460, A-40159, A-42677, A-43272, A-47965, A-49852, A-49924, A-51137, A-60729, A-67940, A-68703, B-06587, B-08344, B-19177, B-19210, B-37402, B-41418, B-43481, B-43863, B-44121, B-45078, B-45757, B-46050, B-50435, B-52445, B-52852, B-53603, B-53867, B-55678, B-56591, B-63775, B-64428, B-66947, B-76512, C-18264, C-26729, C-30432, C-46443, C-49391, D-09590, D-25093, D-41979, D-47982, D-49860, G-24392, G-38616, H-11157, H-11456, H-23661, H-23874, H-28477, H-30225, H-36742, H-36998, H-38017, H-39493, H-40201, H-42601, H-43492, H-45022, H-45160, H-46733, H-48377, H-56655, H-68122, H-80575, I-07553, I-08076, I-24308, I-27060, I-39031, I-46606, I-47291, I-52320, I-56143, I-73616, J-30696, J-39910, J-48171, L-06939, L-09677, L-25642, L-37747, L-39306, L-39749, L-40461, L-48788, L-67886, N-21287, N-69692
CONTACT PROCESS A-42680, A-60728, B-24033, B-32461, B-35111, B-36716, B-60864
CONTINUOUS MONITORING B-24683, B-49031, C-01593, C-02681, C-05078, C-06112, C-06279, C-06397, C-06494, C-11041, C-11574, C-11779, C-12451, C-14288, C-15171, C-16109, C-18696, C-21881, C-22458, C-22877, C-22879, C-23767, C-23907, C-24118, C-24279, C-24372, C-24399, C-25223, C-25487, C-25647, C-26121, C-26122, C-26396, C-26692, C-26981, C-27248, C-27294, C-27430, C-27769, C-28102, C-28671, C-29198, C-29426, C-30007, C-31115, C-32534, C-32643, C-35737, C-35956, C-36002, C-36125, C-37579, C-38280, C-39022, C-39871, C-40211, C-40409, C-43570, C-43979, C-43986, C-44253, C-45344, C-46034, C-47218, C-48492,

C-49391, C-49509, C-49752, C-49879, C-50470, C-51762, C-55858, C-58278, C-61103, C-69174, C-80935, D-06809, D-10619, D-22348, D-26026, D-30058, D-31396, D-37502, D-40896, D-44267, D-48850, D-49118, E-04987, G-01096, G-10333, G-30385, G-31234, G-33510, G-33561, G-41685, G-41686, G-41687, G-41688, G-66044, H-03549, H-06459, H-28149, H-31448, H-36742, H-41370, J-42746, L-17472, L-33495

CONTROL AGENCIES A-36377, A-47143, B-25638, D-26702, H-79976, K-31968, L-17472, L-17614, L-19064, L-19434, L-24122, L-29818, L-32173, L-33495, L-46561, L-47380, L-48788, L-52026, L-59722, L-76965

CONTROL EQUIPMENT - GAS STREAMS A-00340, A-00896, A-01125, A-01687, A-02312, A-02847, A-03129, A-04068, A-05040, A-05090, A-05139, A-05587, A-05601, A-06371, A-08102, A-08116, A-08748, A-08816, A-08882, A-09214, A-09321, A-09332, A-09541, A-09651, A-09690, A-09692, A-09693, A-09694, A-09695, A-09696, A-09697, A-09799, A-11341, A-11541, A-11590, A-11876, A-11877, A-12470, A-12474, A-12476, A-12587, A-12622, A-12676, A-12692, A-12740, A-12741, A-12747, A-12749, A-12750, A-12773, A-12809, A-12813, A-12822, A-12828, A-12884, A-12886, A-12888, A-12889, A-12919, A-12929, A-12931, A-12933, A-15452, A-17076, A-17883, A-20134, A-21380, A-22547, A-26136, A-26254, A-26329, A-29519, A-30296, A-30447, A-31134, A-31144, A-31283, A-31529, A-31935, A-32139, A-33853, A-35985, A-37562, A-39460, A-40159, A-40180, A-40471, A-41650, A-41877, A-42677, A-42683, A-42731, A-42751, A-43270, A-43272, A-44490, A-46119, A-47962, A-47963, A-47965, A-47966, A-48231, A-48429, A-48849, A-49617, A-50013, A-50938, A-52664, A-52741, A-52912, A-53874, A-54622, A-55601, A-58939, A-60421, A-68823, B-02541, B-02962, B-04368, B-04794, B-05567, B-06587, B-07190, B-07549, B-07552, B-07664, B-07815, B-08344, B-09773, B-09902, B-10372, B-10618, B-11686, B-12288, B-13676, B-14444, B-15322, B-15372, B-15813, B-16962, B-17463, B-17485, B-18144, B-18641, B-18698, B-18699, B-18826, B-18830, B-19177, B-19210, B-19212, B-19487, B-21034, B-21795, B-22040, B-22484, B-22598, B-22853, B-22913, B-22923, B-22943, B-23182, B-23370, B-24033, B-24110, B-24116, B-24355, B-24834, B-25135, B-25195, B-25433, B-25523, B-25590, B-25658, B-26244, B-26279, B-26317, B-26401, B-26674, B-26745, B-27282, B-27569, B-27835, B-28034, B-28320, B-28502, B-28783, B-28786, B-29114, B-29403, B-29680, B-29725, B-30276, B-30519, B-30814, B-31567, B-31708, B-31889, B-32231, B-32232, B-32384, B-32461, B-32627, B-32712, B-33191, B-33620, B-33918, B-33971, B-35106, B-35111, B-35448, B-35513, B-36405, B-36475, B-36532, B-36552, B-36716, B-36755, B-37080, B-37115, B-37293, B-37402, B-37509, B-37544, B-37745, B-37809, B-37914, B-38082, B-38115, B-38188, B-38439, B-38504, B-38587, B-38593, B-38874, B-39104, B-40251, B-40381, B-40414, B-40712, B-42078, B-42083, B-42104, B-42172, B-42287, B-42458, B-43299, B-43481, B-43533, B-44343, B-44638, B-44716, B-44793, B-44838, B-45004, B-45078, B-45254, B-45380, B-45468, B-45544, B-45707, B-45757, B-45846, B-46050, B-46086, B-47054, B-47086, B-47095, B-47125, B-47186, B-47256, B-47341, B-47463, B-47466, B-47677, B-47680, B-47821, B-48143, B-48480, B-48805, B-48814, B-48879, B-49023, B-49031, B-49420, B-49477, B-49929, B-49979, B-50154, B-50435, B-50652, B-50868, B-50937, B-51101, B-51845, B-52094, B-52172, B-52179, B-52838, B-52852, B-53620, B-53867, B-53868, B-53875, B-54310, B-54799, B-55046, B-55180, B-55524, B-55678, B-56057, B-56064, B-56078, B-58879, B-58993, B-59230, B-59459, B-59845, B-59861, B-60075, B-60255, B-60282, B-60864, B-67954, C-00126, C-01313, C-01593, C-02681, C-03527, C-04038, C-04540, C-06112, C-07710, C-07871, C-10632, C-11041, C-11404, C-12334, C-12593, C-18264, C-19500, C-21806, C-22517, C-22812, C-23096, C-23575, C-23947, C-24118, C-24372, C-25180, C-25487, C-25816, C-26209, C-26692, C-27044, C-28251, C-28285, C-28374, C-28738, C-29426, C-29738, C-29771, C-29887, C-30300, C-30432, C-32450, C-33711, C-34125, C-35108, C-35956, C-36693, C-38741, C-38905, C-39022, C-39288, C-41020, C-41064, C-41491, C-42926, C-44552, C-48916, C-52206, C-53876, C-55858, C-55923, C-60278, D-06809, D-09590, D-23845, D-25093, D-28097, D-30058, D-32679, D-37502, D-37823, D-49860, D-52578, D-58339, E-04987, E-29315, E-33579, F-44721, F-55435, G-01674, G-06485, G-40527, H-09265, H-02200, H-11456, H-18319, H-21364, H-26711, H-32897, H-33468, H-35880, H-38017, H-38412, H-39537, H-39782, H-58507, I-07553, I-23108, I-39031, J-29923, J-30226, J-39910, J-48171, K-31968, K-33107, L-17472, L-24122, L-24481, L-25427, L-29598, L-32884, L-33722, L-38573, L-42873, L-59722, N-28923, N-44066, N-46820

CONTROL METHODS-ROOMS B-80213

CONTROL METHODS-ROOMS AND OBJECTS B-80213

CONTROL PROGRAMS A-02312, A-03129, A-03450, A-09765, A-38657, A-47954, A-60421, A-61570, A-76274, A-83637, B-09664, B-24683, B-49031, B-72139, D-31371, D-33309, D-47976, G-62596, G-71484, H-48022, H-48377, H-79976, K-31968, L-06754, L-09677, L-19434, L-24481, L-29598, L-29818, L-31492, L-32354, L-37747, L-37943, L-40461, L-42021, L-42188, L-42873, L-42874, L-44054, L-46561, L-48719, L-48788, L-50180, L-57270, L-66700, L-73836, L-73839, L-76847, L-78484, L-81220, L-82278, N-12307, N-50748, N-50867, N-63463

CONTROLLED ATMOSPHERES B-04853, B-12465, C-01349, C-07710, C-22812, E-37013, F-52013, G-08031, H-00187, H-00265, H-00266, H-02379, H-03549, H-03571, H-07255, H-08513, H-11100, H-11407, H-23516, H-28479, H-39782

CONVECTION B-25523

COOLING A-23022, A-23561, A-37562, A-70069, B-18826, B-25523, B-29114, B-37745, B-37809, B-38115, B-38504, B-65638, B-70840, C-01313, C-29771, C-35956, F-44721

COOLING TOWERS A-80507, B-71472, F-44721

COPPER A-17471, A-30447, A-30517, A-42676, A-43014, A-49924, A-55212, A-60728, B-07815, B-28786, B-45380, B-48805, B-48811, B-58879, C-09770, D-33858, G-01096, G-11467, H-08884, H-22930, H-38017, I-00085, I-00695, I-07553, I-23108, I-40510, I-40833, I-46606, J-30696, L-59722

COPPER ALLOYS A-30447, A-30517, A-42676, B-07815, G-01096, I-00695, I-40510

COPPER COMPOUNDS A-09785, A-27314, A-30447, A-40344, A-43014, A-51100, A-52741, A-57231, A-60728, A-60866, A-74262, A-75077, A-76638, A-80238, A-80994, A-81343, A-82279, B-12465, B-28786, C-28126, C-38280, C-39136, C-39516, C-50936, C-55789, C-75339, C-82552, D-17102, D-33858, D-36806, D-50307, D-51929, D-69144, D-83399, E-29910, G-36723, G-39833, G-47807, G-52029, G-71933, G-80197, H-08884, H-13474, H-29443, H-29597, H-45467, H-47286, H-50729, H-51754, H-61496, H-65179, H-67348, H-71078, H-77325, K-44310, K-68224, L-82278

COPPER PRIMARY SMELTING AND REFINING B-83134

CORE OVENS I-07553

CORN C-00626, C-04757, C-18230, G-11444, G-24580, H-00631, H-00633, H-00920, H-00964, H-01800, H-03360, H-04678, H-04984, H-06342, H-10673, H-13247, H-16222, H-16900, H-17449, H-19863, H-21000, H-21498, H-23222, H-26717, H-28443, H-29010, H-70607, H-78956, H-81495, K-07605, K-26738

CORROSION A-08816, A-22973, A-31134, A-37562, A-47954, A-48231, A-52508, A-54622, B-14444, B-37402, B-37809, B-38115, B-41418, B-50435, B-52852, B-73031, C-09770, D-09590, D-09658, D-26086, E-05054, G-32607, I-00085, I-00695, I-07553, I-08076, I-23108, I-27060, I-39031, I-40510, I-40833, I-46606, I-54961, I-56143, I-58585, I-63871, I-65935, I-73616, K-58638, L-24481

COST ANALYSIS C-84463

COSTS A-01125, A-01687, A-22875, A-40180, A-41650, A-47962, A-47965, A-47966, A-58939, A-61154, A-68823, B-07552, B-09664, B-09773, B-09902, B-10372, B-19177, B-23182, B-23370, B-25178, B-25433, B-25523, B-26911, B-27282, B-30519, B-31567, B-36405, B-36755, B-37536, B-38115, B-38476, B-40712, B-40892, B-42078, B-43299, B-44638, B-44838, B-44979, B-45004, B-45078, B-45757, B-47341, B-47731, B-48805, B-48811, B-49023, B-49979, B-50652, B-52094, B-52838, B-52852, B-55678, B-56078, B-59459, B-59845, B-64428, B-64977, B-66947, B-67137, B-69131, B-72139, B-73031, B-77475, C-25631, C-46034, C-51762, C-74346, C-75339, D-29040, D-49860, E-02325, H-11456, H-12045, H-41698, H-56428, H-70984, I-69995, J-28805, J-29923,

J-30696, J-32706, J-38409, J-39910, J-41121, J-42746, J-48171, J-60298, J-67865, J-76213, K-71991, L-24010, L-25427, L-38573, N-63463
COTTON H-01506, H-08884, H-11100, H-81495
COTTON GINNING A-43270, A-71262
COTTONS G-07098, I-07553, L-48788
COUGH A-28038, G-29043, G-40597, G-83798
COULOMETRIC METHODS C-79389, C-83495
COUNTY GOVERNMENTS A-03450, J-32706, L-09677, L-32173, L-32245, L-32272
CRACKING C-29771, C-39022, E-29774, I-07553, K-07605
CRANKCASE EMISSIONS A-59494, L-09677
CRANKCASE VENTILATION AIR A-59494
CRITERIA A-02847, A-03565, A-05040, A-05139, A-05140, A-05587, A-08102, A-08116, A-08748, A-09651, A-09690, A-09692, A-09693, A-09694, A-09695, A-09696, A-09697, A-11341, A-11590, A-11876, A-11877, A-12470, A-12474, A-12587, A-12676, A-12692, A-12740, A-12741, A-12747, A-12750, A-12809, A-12813, A-12822, A-12828, A-12884, A-12886, A-12888, A-12889, A-12919, A-12929, A-12931, A-12933, A-41650, A-41877, A-44490, A-59921, A-67748, A-67834, A-75206, A-76152, A-76190, A-81861, A-83543, B-10372, B-25638, B-26911, B-41378, B-70428, C-03119, C-31115, C-36800, C-39288, C-43672, C-48492, C-49509, C-49992, C-58278, D-09590, G-22628, G-22629, G-34398, G-35670, G-37139, G-52029, G-68551, G-71324, G-74580, H-10673, H-10711, H-13139, H-13985, H-29206, H-38343, H-65558, J-76213, K-07605, K-08420, K-13173, K-14772, K-17375, K-25933, K-26738, K-36823, K-41266, K-41267, K-41295, K-46081, K-47672, K-58899, K-60887, K-67267, K-68224, K-71991, L-09677, L-19064, L-32354, L-32884, L-33722, L-59722, L-64940, L-76965, L-77817
CROP SERVICES A-43270, A-71262, H-00137, H-00301, H-21189, H-22092, H-30368, H-32536, H-37792, H-38568
CROP SPRAYING H-00137, H-00301, H-21189, H-22092, H-30368, H-32536, H-37792, H-38568
CROPS A-00375, A-02312, A-11453, A-31144, A-34018, A-39587, A-48048, A-58334, A-69039, A-71273, A-83543, B-02541, B-04368, B-09664, B-25433, B-30814, C-00126, C-00260, C-00264, C-00626, C-00941, C-01793, C-03478, C-04757, C-18016, C-18230, C-18264, C-20701, C-24886, C-27430, C-29220, C-32029, C-60416, C-72017, D-09590, D-28188, D-30058, D-33108, D-33309, D-44799, D-47976, D-58427, E-37037, E-70747, E-76047, G-01728, G-01794, G-03246, G-05504, G-11444, G-11467, G-19215, G-24580, G-31319, G-74580, G-74822, G-81181, G-84266, H-00187, H-00265, H-00266, H-00301, H-00631, H-00633, H-00654, H-00737, H-00788, H-00920, H-00944, H-00964, H-01250, H-01506, H-01800, H-01809, H-02516, H-03116, H-03360, H-03395, H-03570, H-03571, H-03572, H-03629, H-03729, H-04678, H-04732, H-04923, H-04925, H-04984, H-05398, H-05399, H-05744, H-06342, H-06557, H-08884, H-10673, H-10711, H-11100, H-11456, H-11466, H-12032, H-12042, H-12045, H-12415, H-12552, H-12553, H-13247, H-13804, H-14247, H-15404, H-16150, H-16222, H-16385, H-16387, H-16399, H-16900, H-17449, H-17710, H-17822, H-18266, H-18269, H-19863, H-20157, H-20158, H-20708, H-20872, H-21000, H-21364, H-21422, H-21498, H-21500, H-21687, H-22084, H-22092, H-22496, H-22624, H-23222, H-23386, H-23580, H-23986, H-23988, H-24036, H-24366, H-24548, H-25230, H-26717, H-26800, H-26916, H-26978, H-27006, H-27303, H-28409, H-28443, H-28446, H-28476, H-28647, H-29010, H-29277, H-29443, H-29597, H-30297, H-30298, H-30301, H-30368, H-31124, H-31208, H-31527, H-32280, H-32588, H-32736, H-32771, H-32854, H-33089, H-33290, H-34121, H-34880, H-35877, H-36994, H-36996, H-37567, H-38332, H-38343, H-38404, H-38417, H-38754, H-39159, H-39363, H-39493, H-39537, H-39986, H-40201, H-40202, H-40368, H-41439, H-41699, H-42601, H-42907, H-42958, H-44295, H-45007, H-45009, H-45663, H-45776, H-45781, H-47286, H-47385, H-48167, H-48193, H-48556, H-49316, H-50157, H-50959, H-51321, H-56204, H-56213, H-56515, H-56625, H-56963, H-58941, H-59198, H-59947, H-60760, H-61496, H-62548, H-63442, H-64758, H-65103, H-65715, H-67026, H-67304, H-67480, H-68394, H-68602, H-68770, H-70357, H-70607, H-70745, H-71931, H-74626, H-74722, H-75027, H-76838, H-77050, H-77390, H-77421, H-78956, H-79129, H-79309, H-79586, H-79972, H-79976, H-80064, H-80067, H-80083, H-81288, H-81495, H-83730, H-83849, H-83851, H-83854, H-84290, H-84553, H-84579, H-84651, J-32706, J-43002, J-43547, J-55161, J-60298, J-67865, K-07605, K-26738, L-19064, L-25642, L-31492, L-37943, L-81399
CRYSTAL STRUCTURE C-23657, F-18863, F-26990, F-57580, G-28037, H-04917
CUCUMBERS H-81495, H-83885
CUMULATIVE MEASUREMENT METHODS C-11574, C-12451, C-22517, C-24603, C-29771, C-35108, C-36002, C-39022, C-47218, C-49879, C-56572, D-09590, D-09658, D-23392, D-26026, D-33309, D-37502, D-39054, D-44267, D-48850, D-49118, E-04987, I-00695
CUPOLAS A-00896, A-01528, A-17344, A-29532, A-41650, A-42683, A-42751, A-47962, B-04794, B-25638, B-38115, B-47125, B-47341, H-27324, L-09677, L-48788
CYANATES A-39460, C-36771, G-04927, G-71948, H-25366, K-41682, K-51057
CYANIDES A-31529, A-36377, A-40182, A-71262, A-72133, B-14692, B-47677, B-49023, B-56057, B-62165, B-66592, B-71412, B-75138, B-75204, C-16109, C-21881, C-22458, C-23096, C-24050, C-24603, C-25223, C-28102, C-30793, C-30840, C-31115, C-31712, C-32534, C-36771, C-38280, C-38670, C-39136, C-39516, C-42926, C-43979, C-47218, C-50936, C-61851, C-66753, C-71044, C-74942, C-79003, C-84660, D-76890, F-62189, G-24153, G-49223, G-78873, G-79848, G-84137, H-00301, H-03395, H-12042, H-17710, H-39537, I-23108, I-69995, K-19818, K-44310, K-51057, K-74109, L-29504, L-37747, L-80894, N-63463
CYCLIC ALKANES C-39719, F-02337
CYCLIC CRUDES AND INTERMEDIATE PRODUCTIO A-00896, A-17344, H-39537, L-37747
CYCLONES (CONTROL) A-82192, B-76232, B-82918, K-78880
CZECHOSLOVAKIA A-06241, A-13242, A-17116, A-49852, B-18536, B-18641, B-38439, B-41378, C-00260, C-00941, C-01349, C-01593, C-01793, C-02042, C-02681, C-09983, C-27962, C-33632, C-69668, D-13838, D-14066, E-02325, F-02517, G-01047, G-01096, G-01426, G-04734, G-10203, G-13700, G-14126, G-19880, G-24392, G-37569, G-37684, G-52686, G-62596, H-00137, H-00187, H-00240, H-00265, H-00266, H-00301, H-00633, H-01092, H-02049, H-02379, H-02382, H-03549, H-03570, H-03571, H-03572, H-03612, H-03613, H-03616, H-03860, H-03873, H-13203, H-14678, H-16673, H-20872, H-21062, H-23579, H-23624, H-24787, H-25661, H-25665, H-26491, H-28409, H-32672, H-32673, H-34880, H-36996, H-37480, H-39159, H-41482, H-43663, H-46923, H-47014, H-56874, H-56963, H-57716, H-58381, H-60913, H-77377, I-00085, J-38409, K-41266, K-41267, K-41295, K-68582

D

DATA ANALYSIS C-27430, C-43672, C-44285, D-25593, D-26702, H-01092, H-06459, H-17822, H-20874, H-26734, K-69550, L-33495
DATA HANDLING SYSTEMS A-75146, B-44838, C-05892, C-20540, C-27430, C-42375, C-43672, C-44285, C-58278, C-61103, C-65118, C-65846, C-66606, C-68944, D-25593, D-26702, D-44799, E-02325, E-43855, E-64013, H-01092, H-03613, H-06459, H-17822, H-20874, H-26734, I-00695, J-32706, K-69550, L-33495, L-40889, L-64940, L-81220
DECIDUOUS TREES H-78058, H-78580, H-80067, H-80493
DECISIONS H-11456, L-28014
DECOMPOSITION A-13242, A-34334, A-48572, A-76411, A-84479, B-18536, B-36475, C-08077, C-23517, C-30007, C-31712, F-01677, F-28428, F-69599, L-32789
DEER H-80535
DEFOLIANTS H-49779
DEGREASING A-09785, B-36532
DENSITY B-37544, B-38874, B-47086, C-11574, C-30432, C-32534, H-29206, H-31124, H-31527, I-00085
DEPOSITION A-47954, C-24603, C-35956, E-29774, E-70747, G-10362, G-18809, G-26743, G-28037, G-28199, G-33505, G-33872, G-52686, H-19604, H-26742, H-31124, H-38417, H-38568, H-52829, H-60760, H-60913, H-62597, H-63442, N-21287

DEPOSITION PHENOMENA H-80067
DETERGENT MANUFACTURING A-40344, A-45858, A-47963
DETROIT D-37473, D-42760, L-09677, L-17614
DIAGNOSIS C-36771, C-67116, G-04849, G-06485, G-06675, G-07013, G-07098, G-07344, G-07917, G-08031, G-22551, G-24720, G-25469, G-25946, G-26743, G-29415, G-36751, G-37282, G-37795, G-38106, G-40597, G-40635, G-54302, G-57024, G-80857, H-00240, H-01092, H-01250, H-04848, H-04923, H-04924, H-04997, H-05004, H-05421, H-12554, H-13985, H-17684, H-20690, H-24944, H-25945, H-26734, H-26861, H-26876, H-28031, H-28035, H-28258, H-28679, H-36742, H-38407, H-38419, H-41362, H-42924, H-42954, H-45557, H-50677, H-52705, H-66035, H-76297, H-76901, H-80535, H-81671, H-83182, L-29818
DIESEL ENGINES A-29786, A-34018, A-49924, C-26713, C-35108, D-25593
DIFFRACTION C-09770, C-17098, I-00695
DIFFUSION (ATMOSPHERIC) A-15452, A-17883, A-28038, A-32702, A-35985, A-35985, A-42054, A-44566, A-53874, A-66955, A-70727, A-75146, A-76459, C-03478, C-05439, C-07871, C-22877, C-23546, C-23573, C-24966, C-26713, C-26713, D-09590, D-48791, D-49860, D-49860, D-53889, E-02325, E-02325, E-05054, E-29774, E-33092, E-43855, E-44277, E-44277, E-49185, E-49433, E-59075, E-59075, E-64013, E-77970, E-78793, G-23563, G-26873, H-00265, H-26717, H-29597, H-32343, H-45604, K-34063, K-34063, L-24122, L-24122, L-32884, L-64940, L-76847, N-64545, N-64937
DIFFUSION MODELS A-35985, A-66955, A-75146, A-76459, C-26713, D-49860, E-02325, E-44277, E-59075, E-64013, E-78793, K-34063, L-24122, L-64940, L-76847, N-64545
DIFFUSION PHENOMENA G-80197
DIGESTERS A-21380
DIGESTION H-04919, H-04924, H-05004, H-18270, H-39493
DIGESTIVE SYSTEM A-63661, A-81169, C-07719, G-03246, G-04849, G-04983, G-06288, G-06497, G-07917, G-08030, G-08031, G-10203, G-11000, G-11467, G-16874, G-19880, G-21455, G-22551, G-22628, G-25946, G-28037, G-28199, G-32601, G-32605, G-32606, G-33505, G-36751, G-37795, G-41685, G-45055, G-49223, G-49448, G-54302, G-79619, G-79980, G-83177, G-83798, H-04850, H-04923, H-04997, H-05004, H-08884, H-11432, H-23624, H-39627, H-48193, H-49434, H-65103, H-79633
DIOLEFINS H-05342, H-05724, H-08884, H-11100, K-07605
DIPHENYLS A-47048, C-17128
DISCOLORATION A-31134, G-18988, H-25750, H-40899, I-07553
DISINTEGRATION N-66750
DISPERSIONS C-43234
DISPLACEMENT C-07860, C-32966
DISSOCIATION F-16218, F-21632, F-22219
DISTILLATE OILS D-40896
DOGS C-07719, G-01426, G-03394, G-06288, G-11000, G-30145, G-30841, G-44594, H-04544, H-12556, H-39895, H-42857
DOMESTIC HEATING A-02312, A-09785, A-11453, A-17357, A-17464, A-36377, A-40344, A-40401, A-40471, A-42675, A-46925, A-47143, A-48849, A-49924, A-55922, A-59494, A-68703, A-69309, B-41378, D-09590, D-21419, D-33309, D-34008, D-35764, D-37502, D-40896, G-01794, G-07098, G-30788, G-31234, G-31319, H-39190, H-41698, I-56143, J-30696, L-19434, L-25427, L-32354, L-32884, L-60630, N-04212, N-16400, N-21287, N-32254
DONORA A-00375, A-32060, G-18785, G-24580, G-28199, G-30788, H-00301, N-28923
DROPLETS A-09785, A-29519, B-24110, B-33971, B-35448, B-42104, B-46086, C-35956, E-30126, I-07553, I-27060
DRUGS G-00165, G-01426, G-04927, G-36723, H-01092, H-13985, H-20690
DRY CLEANING PLANTS (EXCEPT RUG) A-09785, A-34018, A-40344, A-45858, A-47143, N-04212
DRYING A-70069, A-77522, B-38775, B-61741, C-83592
DUMPS B-24683, C-23683
DUST FALL A-00896, A-08882, A-17116, A-36377, A-81931, B-10618, B-47125, C-01593, C-03527, C-11574, C-22812, C-22877, C-24603, C-27130, C-36693, C-39022, C-41763, C-42926, C-43672, C-68944, D-01872, D-09590, D-09658, D-13838, D-22348, D-23845, D-26026, D-27254, D-28097, D-30705, D-33309, D-33858, D-37502, D-39737, D-41979, D-43317, D-44267, D-49860, D-50744, D-52578, D-56464, D-70500, E-04987, E-49185, G-30183, G-37791, H-36998, H-47014, H-77391, K-36823, K-37472, K-80854, L-17614, L-41455, L-47380
DUSTS A-00896, A-01528, A-02312, A-04068, A-05601, A-06371, A-08882, A-09785, A-11453, A-12622, A-15452, A-17076, A-17116, A-17344, A-17471, A-20134, A-22875, A-26254, A-28282, A-29519, A-29532, A-31144, A-32139, A-32519, A-32702, A-34334, A-36377, A-37190, A-37562, A-37752, A-37996, A-38657, A-40180, A-40182, A-40344, A-41877, A-42675, A-42676, A-42677, A-42680, A-42682, A-42683, A-42685, A-42731, A-42751, A-44490, A-44566, A-44605, A-46558, A-47048, A-47188, A-47410, A-47945, A-47954, A-47962, A-47963, A-47965, A-47966, A-48231, A-48429, A-48849, A-48946, A-49617, A-49924, A-50013, A-50381, A-50938, A-51100, A-52508, A-52741, A-52912, A-53295, A-59257, A-59494, A-59775, A-60283, A-60727, A-60728, A-60729, A-60827, A-60866, A-61007, A-61154, A-61570, A-63661, A-64926, A-66977, A-67940, A-68703, A-69039, A-69309, A-70727, A-71273, A-71615, A-72079, A-72125, A-74262, A-75089, A-76274, A-76411, A-76638, A-77367, A-80334, A-80994, A-81169, A-81343, A-81931, A-82192, A-82269, B-02541, B-04368, B-04794, B-07549, B-07664, B-08344, B-09902, B-10618, B-13676, B-15322, B-17463, B-18144, B-18698, B-18699, B-18826, B-19177, B-19571, B-21795, B-22484, B-22943, B-23370, B-24110, B-25433, B-25590, B-25638, B-26279, B-26745, B-26911, B-27282, B-28786, B-29680, B-29725, B-30276, B-30519, B-30814, B-32231, B-32384, B-32461, B-32627, B-32963, B-33620, B-33918, B-33971, B-35106, B-35111, B-35513, B-36405, B-36716, B-37402, B-37603, B-37914, B-38082, B-38115, B-38439, B-38593, B-38874, B-40414, B-40892, B-42104, B-43108, B-44638, B-44716, B-45004, B-45380, B-45468, B-45544, B-47086, B-47125, B-47256, B-47341, B-47463, B-47821, B-48805, B-48811, B-49023, B-49979, B-50154, B-55524, B-60255, B-60282, B-60849, B-60864, B-61259, B-63474, B-63784, B-64977, B-65638, B-65640, B-66624, B-67700, B-67742, B-67954, B-70428, B-70658, B-70840, B-72038, B-72139, B-74480, B-74483, B-78814, B-79079, B-79657, B-79711, B-80356, B-80500, B-81040, B-81256, B-81773, B-83198, C-00450, C-01593, C-03527, C-09983, C-11915, C-16801, C-17098, C-20595, C-20892, C-22877, C-23575, C-26729, C-28671, C-29737, C-29738, C-30300, C-30432, C-32534, C-35108, C-35441, C-38741, C-41064, C-41763, C-43234, C-43570, C-44238, C-46443, C-48392, C-49509, C-52206, C-52992, C-53625, C-55367, C-58278, C-58842, C-59814, C-61851, C-66606, C-68944, C-70686, C-76212, C-84660, D-09590, D-17102, D-19966, D-21419, D-22348, D-25593, D-28097, D-31396, D-32666, D-33017, D-33108, D-33309, D-33858, D-34008, D-39182, D-39737, D-40896, D-44799, D-49260, D-49860, D-50690, D-54881, D-56464, D-60574, D-62438, D-63186, D-69144, D-73286, D-78193, D-78442, D-78954, D-79343, D-83399, E-29910, E-59234, E-62869, E-78933, G-01794, G-02539, G-03394, G-04145, G-04734, G-06485, G-07013, G-07098, G-07344, G-07961, G-08201, G-08702, G-10362, G-11000, G-12532, G-14319, G-18809, G-18987, G-26274, G-28556, G-30183, G-30788, G-30841, G-31319, G-32605, G-32607, G-34398, G-37791, G-38721, G-39494, G-40527, G-40635, G-43636, G-48697, G-49164, G-49756, G-50916, G-52638, G-60228, G-61146, G-61467, G-68583, G-72961, G-84137, G-84233, H-03116, H-08884, H-11157, H-12533, H-16673, H-19604, H-20707, H-20708, H-27021, H-27324, H-28474, H-29736, H-30225, H-30805, H-32588, H-32982, H-35613, H-35964, H-36996, H-36998, H-37346, H-38332, H-38411, H-38417, H-38574, H-39190, H-40368, H-41439, H-41983, H-42086, H-42601, H-42857, H-43622, H-45007, H-45160, H-45467, H-46338, H-46719, H-47014, H-47286, H-47385, H-48941, H-52928, H-54297, H-54397, H-56637, H-56655, H-56885, H-60957, H-60961, H-61496, H-67453, H-68575, H-69596, H-74626, H-77329, H-77391, H-79976, H-80575, H-81288, H-81671, H-81771, H-82520, H-83145, H-83258, H-84080, H-84290, H-84548, I-00695, I-24308, I-63139, J-48171, K-27010, K-28466, K-31968, K-33107, K-34063, K-36823, K-38197, K-41682, K-42039, K-51057, K-60180, K-68582, K-72151, K-80854, L-06754, L-09677, L-17188, L-17472, L-17614, L-19434, L-25542, L-25642, L-27677, L-28349, L-29598, L-29818, L-30620, L-32173, L-32245, L-32272, L-32884, L-35795, L-37747, L-37943, L-38669, L-40461, L-41455,

L-42873, L-42874, L-44054, L-48719, L-52026, L-76397, L-80894, L-81220, N-04212, N-16400, N-21287, N-37027, N-50867, N-51942, N-64545, N-64937
DYE MANUFACTURING A-00896, A-17344, H-39537, L-37747

E

ECONOMIC LOSSES A-22973, A-30517, A-34018, A-47954, B-09664, B-26911, H-01250, H-03116, H-03395, H-03612, H-03616, H-05421, H-11456, H-17710, H-18269, H-19713, H-20157, H-22789, H-23624, H-25865, H-26158, H-36787, H-39466, H-39537, H-45540, H-46262, H-49779, H-70984, H-79976, I-27060, J-28805, J-30226, J-32706, J-38409, J-43002, J-43547, J-44672, J-55161, J-60298, L-25642
ECONOMICS A-01125, A-01687, A-22875, A-22973, A-30517, A-34018, A-40180, A-41650, A-47954, A-47962, A-47965, A-47966, A-58939, A-61154, A-68823, B-07552, B-09664, B-09773, B-09902, B-10372, B-19177, B-23182, B-23370, B-25178, B-25433, B-25523, B-26911, B-27282, B-30519, B-31567, B-36405, B-36755, B-37536, B-38115, B-38476, B-40712, B-40892, B-42078, B-43299, B-44638, B-44838, B-44979, B-45004, B-45078, B-45757, B-47341, B-47731, B-48805, B-48811, B-49023, B-49979, B-50652, B-52094, B-52838, B-52852, B-55678, B-56078, B-59459, B-59845, B-64428, B-64977, B-66947, B-67137, B-69131, B-72139, B-73031, B-77475, B-80213, B-81040, B-81944, C-25631, C-46034, C-51762, C-74346, C-75339, C-84463, D-29040, D-49860, E-02325, H-01250, H-03116, H-03395, H-03612, H-03616, H-05421, H-11456, H-12045, H-17710, H-18269, H-19713, H-20157, H-22789, H-23624, H-25865, H-26158, H-36787, H-39466, H-39537, H-41698, H-45540, H-46262, H-49779, H-56428, H-70984, H-79976, I-27060, I-69995, J-28805, J-29923, J-30226, J-30696, J-32706, J-38409, J-39910, J-41121, J-42746, J-43002, J-43547, J-44672, J-48171, J-55161, J-60298, J-67865, J-76213, K-71991, K-81864, L-24010, L-25427, L-25642, L-38573, N-63463
EDUCATION A-47954, B-26911, B-41569
EFFICIENCY A-40344, A-60727, A-68823, A-74586, A-76122, B-41418, B-60849, B-61259, B-61935, B-64696, B-64977, B-65638, B-66618, B-67700, B-69965, B-72656, B-74483, B-75138, B-75387, B-76232, B-77475, B-78245, B-78814, B-80213, B-81256, B-81772, B-84418, C-61896, C-64779, C-68086, C-69765, C-71244, C-72015, C-73349, C-75058, C-75339, C-76030, C-84214, C-84499, D-66083, K-66916
ELECTRIC BATTERIES B-28502
ELECTRIC FURNACES A-09693, A-09799, A-12622, A-41877, A-42682, A-45858, A-49617, A-52912, A-59775, A-60866, A-64926, A-72125, B-02962, B-07664, B-10618, B-25038, B-29680, B-45380, B-47821, D-39737, H-83258, L-29598, L-30620
ELECTRIC POWER GENERATION A-00375, A-01687, A-02312, A-09785, A-12557, A-13699, A-17357, A-17464, A-17883, A-22875, A-24039, A-25305, A-29519, A-31315, A-32139, A-32519, A-34018, A-36377, A-39460, A-40344, A-40401, A-42675, A-42685, A-46558, A-47143, A-47410, A-47966, A-48849, A-49924, A-53751, A-55601, A-61007, A-61800, A-66977, A-67940, A-68703, A-69309, A-69422, A-80334, A-80507, A-81343, A-81917, A-81931, A-81935, B-10618, B-12127, B-24033, B-24683, B-25038, B-26911, B-32232, B-36552, B-38476, B-40381, B-40712, B-41378, B-43863, B-44979, B-45078, B-45846, B-47054, B-60849, B-65638, B-67700, B-80500, C-22812, C-44238, C-75058, D-09590, D-09658, D-31396, D-32666, D-33309, D-49860, D-56464, E-59234, F-13998, F-44721, G-01794, G-07098, G-50161, H-01398, H-16385, H-17697, H-23624, H-36998, H-38574, H-41698, H-45130, H-48374, H-65179, H-69596, H-70487, H-74624, I-56143, J-30696, J-38409, J-39910, K-34063, K-37472, L-17472, L-19434, L-25427, L-29421, L-29598, L-30620, L-32884, L-39306, L-39749, L-57270, L-84415, N-04212, N-21287
ELECTRIC POWER SOURCES B-28502, L-32245, L-46561
ELECTRIC, GAS, AND SANITARY SERVICES A-00375, A-01687, A-02312, A-03450, A-05601, A-08816, A-09785, A-11590, A-11876, A-12557, A-12773, A-12889, A-13699, A-17357, A-17464, A-17883, A-22875, A-23865, A-24039, A-25305, A-26254, A-29519, A-29532, A-29786, A-30218, A-31315, A-31529, A-32139, A-32519, A-32702, A-32855, A-34018, A-34334, A-35985, A-36377, A-37562, A-37996, A-39460, A-40344, A-40401, A-42675, A-42685, A-45858, A-46558, A-47048, A-47143, A-47188, A-47410, A-47954, A-47963, A-47966, A-48231, A-48849, A-49924, A-50013, A-50381, A-50938, A-50961, A-51100, A-51102, A-51137, A-52508, A-52741, A-53295, A-53751, A-54622, A-55601, A-60727, A-61007, A-61800, A-66977, A-67940, A-68703, A-69309, A-69422, A-71262, A-71615, A-74262, A-75077, A-75146, A-80334, A-80507, A-80994, A-81343, A-81745, A-81917, A-81931, A-81935, A-82192, B-10618, B-12127, B-24033, B-24683, B-25038, B-25638, B-26911, B-28502, B-29680, B-32231, B-32232, B-35111, B-36552, B-36716, B-37536, B-38439, B-38476, B-40381, B-40712, B-41378, B-43840, B-43863, B-44716, B-44979, B-45078, B-45846, B-47054, B-47677, B-47680, B-49929, B-49979, B-50154, B-50937, B-51101, B-51845, B-55180, B-56078, B-58879, B-59845, B-60849, B-61259, B-61954, B-64696, B-65638, B-67700, B-68795, B-70840, B-71796, B-73031, B-74480, B-74483, B-78814, B-78890, B-79657, B-79711, B-80500, B-80950, B-81256, B-82446, B-83667, C-22812, C-23683, C-35956, C-36002, C-40211, C-44238, C-52992, C-75058, C-75339, C-80935, D-09590, D-09658, D-25393, D-31396, D-32666, D-33309, D-37994, D-41979, D-49860, D-56464, D-71272, E-59234, F-13998, F-44721, G-01794, G-07098, G-31319, G-32607, G-50161, H-01398, H-16385, H-17697, H-23624, H-25366, H-36998, H-38574, H-40460, H-41698, H-42923, H-43226, H-45130, H-48374, H-65179, H-69596, H-70487, H-74624, I-07553, I-39031, I-56143, I-65935, J-30696, J-38409, J-39910, J-48171, K-10168, K-34063, K-37472, K-51212, K-51229, K-72151, K-74109, K-78880, L-09677, L-17472, L-19434, L-25427, L-29421, L-29598, L-30620, L-32173, L-32245, L-32272, L-32884, L-37747, L-39306, L-39749, L-40461, L-48788, L-57270, L-77234, L-84415, N-04212, N-21287
ELECTRICAL AND ELECTRONIC EQUIPMENT PLAN A-09785
ELECTRICAL MEASUREMENT DEVICES C-01313, C-04405, C-04689
ELECTRICAL PROPERTIES A-28038, A-42731, B-47341, C-04685, C-08077, C-44177, C-68944, F-18863, F-21389, G-28041, H-00265, H-28149, I-00695
ELECTRICAL RESISTANCE A-42731, H-00265, I-00695
ELECTRICITY (ATMOSPHERIC) D-29040
ELECTROCHEMICAL METHODS A-61564, A-75077, B-29680, C-02681, C-06983, C-07871, C-08077, C-09983, C-12334, C-12760, C-18344, C-20892, C-20895, C-21156, C-22812, C-23517, C-25210, C-27248, C-27341, C-27769, C-27962, C-28374, C-28671, C-28843, C-29198, C-29467, C-29887, C-30014, C-30793, C-31712, C-32534, C-33632, C-35737, C-35956, C-36800, C-37350, C-37463, C-37515, C-37579, C-38741, C-39008, C-39022, C-39243, C-39719, C-39762, C-41064, C-41491, C-43979, C-43985, C-43986, C-44177, C-44238, C-44253, C-44933, C-46034, C-47218, C-49509, C-49752, C-49992, C-50470, C-50936, C-51599, C-51762, C-52629, C-53523, C-53625, C-53876, C-53987, C-55923, C-56681, C-57781, C-58278, C-58842, C-59049, C-60951, C-61896, C-61995, C-63848, C-64779, C-64912, C-67116, C-68229, C-69174, C-69675, C-69765, C-70638, C-71232, C-71245, C-73349, C-74221, C-74346, C-75339, C-77427, C-79389, C-83495, D-28097, D-61140, E-04987, E-43424, F-34948, G-09575, G-71324, G-74380, H-39328, H-42946, H-50729
ELECTROLYSIS A-23022, A-30447, A-42676, A-44605, A-50018, A-55407, A-68807, B-13676, B-23370, B-24116, B-26279, B-26317, B-30519, B-38082, B-38445, B-38593, B-38775, B-38874, B-40414, B-44343, B-48811, B-48814, B-52838, B-53603, B-55524, B-56528, B-59679, B-60206, B-60255, B-61273, B-63784, B-69191, B-70659, C-06397, C-06983, C-08077, C-10632, C-16109, C-21881, C-26692, C-31712, C-35737, C-37463, C-37515, C-37579, C-41064, C-83495, D-27254, D-37823, E-37013, F-39861, H-26978, I-00695
ELECTROMAGNETIC ABSORPTION C-80259, F-80516
ELECTRON MICROSCOPY A-50013, C-17098, C-42928, C-52206, G-11000, I-08076
ELECTROSTATIC COUNTERS C-48916, C-52206, C-61957

ELECTROSTATIC PRECIPITATORS
A-01687, A-04068, A-08748, A-09541, A-09799, A-11341, A-12476, A-12587, A-12676, A-12692, A-12773, A-15452, A-17076, A-26329, A-29519, A-40159, A-40180, A-40344, A-41650, A-41877, A-42731, A-42751, A-43014, A-43270, A-44490, A-47962, A-47963, A-47965, A-47966, A-48231, A-48429, A-48849, A-50013, A-50938, A-52741, A-60827, A-60866, A-67940, A-68703, A-71615, A-74262, A-75206, A-81861, A-82192, B-04794, B-07664, B-09902, B-10618, B-18699, B-21795, B-22484, B-22853, B-22943, B-23182, B-23370, B-24033, B-25135, B-25433, B-25658, B-27569, B-28034, B-28320, B-28502, B-29680, B-29725, B-30519, B-31567, B-31708, B-32231, B-32461, B-32627, B-32712, B-35106, B-36405, B-36552, B-36755, B-37544, B-38168, B-38593, B-43299, B-44343, B-44838, B-44979, B-45078, B-45254, B-45544, B-46050, B-47125, B-47341, B-47677, B-47680, B-48805, B-49023, B-50154, B-51101, B-52838, B-59230, B-60282, B-61259, B-63474, B-63775, B-64696, B-65640, B-69965, B-70428, B-70840, B-71796, B-78814, B-78890, B-80213, B-80500, B-81256, B-84418, C-00126, C-06112, C-07871, C-23096, C-27044, C-28285, C-29771, C-35956, C-42926, C-55923, C-60951, C-68086, C-79032, D-23845, D-32679, E-04987, F-44721, J-29923, J-48171, J-76213, K-33107, K-66860, L-32884, L-38573
ELM TREES H-80493
EMERGENCIES A-76274, D-84625, H-79976
EMISSION FACTORS A-75206, A-76152, A-76190, A-76459, A-79043, A-81861, A-81916, A-81935
EMISSION INVENTORIES A-13701, A-27617, A-40344, A-47143, A-67806, A-69309, A-75089, C-27248, D-09590, D-26086, D-26702, D-49860, K-36823
EMISSION SPECTROMETRY C-80227, C-82650
EMISSION STANDARDS A-01687, A-03129, A-29519, A-34096, A-36377, A-37190, A-38657, A-41650, A-42683, A-47963, A-68823, A-70069, A-70727, B-19212, B-25638, B-40414, B-47054, B-49031, B-53875, B-55678, B-56057, B-65640, B-78814, B-81256, C-35108, C-36800, C-41719, D-25593, D-28188, D-41979, D-42769, G-44597, G-47807, G-71484, G-71617, H-44295, H-69162, J-30696, K-14772, K-33107, K-34063, K-36823, K-37472, K-38197, K-42039, K-44310, K-44377, K-46081, K-47672, K-51212, K-51229, K-58899, K-60180, K-66860, K-66916, K-68582, K-71991, K-72151, K-74109, K-79255, K-80854, L-06938, L-06939, L-09677, L-19064, L-19434, L-20273, L-28349, L-29421, L-31492, L-32173, L-32245, L-32272, L-32884, L-33722, L-35795, L-37747, L-38669, L-39306, L-42021, L-42188, L-42873, L-44054, L-46586, L-47380, L-48719, L-48788, L-50180, L-66700, L-73839, L-77817, L-81399, N-50748, N-64545
EMISSIVITY C-01313, H-03571
EMPHYSEMA A-00375, G-11467, G-16874, G-30788, G-30841, G-33505, G-41684, G-43636, G-74369, G-83798, H-03766, H-08884, H-11452, J-30226, N-64937
ENCAPSULATION B-38082, B-56528
ENFORCEMENT PROCEDURES
A-01528, B-09664, B-25638, C-79842, L-19064, L-19434, L-29421, L-30620, L-31492, L-35795, L-37747, L-38669, L-42874, L-76965, N-50867
ENGINE DESIGN MODIFICATION
B-02541, B-28502, L-31492
ENGINE EMISSIONS A-00375, A-08882, A-09785, A-11453, A-20134, A-23561, A-27595, A-28038, A-29786, A-31315, A-32060, A-34018, A-42675, A-47143, A-47945, A-47954, A-47959, A-48849, A-49924, A-50242, A-55922, A-59494, A-68703, A-69309, A-76274, B-07549, B-29680, B-35106, B-37402, B-45846, B-49031, B-76008, B-83613, C-03119, C-06112, C-22812, C-26713, C-27248, C-35108, C-35737, C-49879, C-61851, C-69152, C-74346, D-23845, D-25593, D-27254, D-33108, D-34008, D-40896, D-41979, D-42760, G-27379, G-30788, G-31319, G-32607, G-38721, G-41706, G-47807, G-50318, H-01398, H-03116, H-03612, H-03766, H-08884, H-18319, H-19604, H-19656, H-20157, H-21189, H-25769, H-28474, H-28475, H-32714, H-39923, H-40460, H-41699, H-42857, H-43622, H-46338, H-47014, H-49316, H-49647, H-50157, H-51321, H-54597, H-54755, H-60957, H-73518, H-74624, H-84548, I-23108, J-42746, K-19818, K-34063, K-58899, K-71991, K-72151, K-80854, L-09677, L-17472, L-24122, L-29598, L-30620, L-31492, L-32354, L-32789, L-40461, L-42021, L-42810, L-42873, L-44054, L-46561, L-48719, L-50180, L-52026, L-60630, L-61705, L-64940, L-84415, N-04212, N-17260, N-21287, N-50867, N-64545, N-64937, N-65407
ENGINE OPERATING CYCLES L-31492
ENGINE OPERATION MODIFICATION
A-33853, B-02541, B-33554, B-35106, L-24122, N-20495
ENGINEERS B-37603, B-51845, D-26702, N-37027
ENGINES A-20134, A-29786, A-34018, A-48946, A-49924, B-07549, B-35111, B-65638, B-67700, B-75138, C-26713, C-35108, D-25593, D-34008, L-09677, L-24122
ENZYMES A-11916, A-81169, C-36800, F-22219, G-01728, G-04734, G-04927, G-07917, G-11000, G-13215, G-24720, G-32605, G-32606, G-33510, G-33511, G-38106, G-40920, G-41685, G-41687, G-43277, G-48068, G-49164, G-66668, G-68583, G-74822, G-79796, G-79848, H-00737, H-00788, H-00920, H-04918, H-05004, H-05399, H-06342, H-07046, H-07047, H-08513, H-08884, H-10150, H-10843, H-12032, H-14121, H-17749, H-23794, H-28437, H-29616, H-30234, H-39466, H-41189, H-46719, H-48193, H-52306, H-59198, H-60560, H-62548, H-64588, H-66714, H-73518, H-76451
EPIDEMIOLOGY A-00375, A-45145, G-02539, G-03394, G-05833, G-06675, G-11942, G-12987, G-16345, G-16874, G-22629, G-23003, G-26846, G-28019, G-28754, G-29415, G-37791, G-38616, G-38942, G-43636, G-44867, G-48693, G-48697, G-49164, G-49607, G-50414, G-56538, G-56933, G-60228, G-61467, G-66044, G-68520, G-71484, G-71536, G-73657, G-81181, G-84266, H-05004, H-05560, K-36823, N-49170
EPITHELIUM A-00640, G-01047, G-03246, G-14319, G-40597, G-79619, G-79623
EQUIPMENT CRITERIA B-10372, B-41378, C-39288, C-48492, C-49992, L-32354, L-33722
EQUIPMENT STANDARDS B-25638, C-35108, C-48492, C-49509, C-49992, C-74346, D-25593, K-19818, K-34063, K-78880, K-79255, L-32173, L-32245, L-32272, L-38669, L-39306
ESTERS C-08077, C-20701, C-25441, C-83592, G-24720, H-02382, K-51057, L-32173, L-32245
ETHERS C-39719, C-83592, H-39537, K-51057, L-32173, L-32245
ETHNIC FACTORS G-06497
ETHYL ALCOHOL G-07098
ETHYLENE A-18449, A-44566, A-48572, B-02541, B-26911, B-28502, B-59230, B-62165, C-17128, C-27769, C-38670, C-50337, C-66753, E-76047, F-02337, F-25636, F-59528, G-28041, G-45683, G-48068, G-72961, G-79848, G-84260, H-00737, H-01809, H-02537, H-03395, H-03472, H-03611, H-03612, H-03613, H-03616, H-03766, H-04984, H-05342, H-05421, H-05485, H-05724, H-08884, H-11100, H-12042, H-12045, H-12155, H-13474, H-17710, H-17749, H-17779, H-20157, H-20158, H-21364, H-22789, H-25865, H-26055, H-26158, H-26861, H-30473, H-33127, H-40202, H-41699, H-41983, H-42923, H-45130, H-45214, H-45540, H-46262, H-46338, H-48413, H-49779, H-50780, H-52102, H-52409, H-52698, H-52928, H-54755, H-56655, H-60907, H-65928, H-67026, H-67056, H-67304, H-67348, H-67457, H-70984, H-78580, H-84651, J-32706, J-55161, K-03582, K-07605, K-47672, K-51057, K-71991, L-44054, N-63463
EUROPE A-00220, A-00375, A-00640, A-00896, A-01528, A-02653, A-02988, A-03129, A-04068, A-05090, A-06241, A-06371, A-08486, A-08816, A-09541, A-11453, A-11916, A-13242, A-13701, A-17076, A-17116, A-17344, A-17357, A-17377, A-17464, A-17471, A-17883, A-23022, A-23865, A-25305, A-26329, A-27314, A-27930, A-28282, A-29519, A-29786, A-30218, A-30296, A-30517, A-31134, A-31283, A-31315, A-31333, A-32060, A-32519, A-33735, A-34096, A-34334, A-36045, A-36212, A-37190, A-37562, A-37752, A-37996, A-38657, A-39635, A-40401, A-40471, A-40600, A-42675, A-42677, A-42680, A-42682, A-42685, A-42731, A-44605, A-46119, A-46925, A-47048, A-47061, A-47410, A-47954, A-47959, A-47962, A-47963, A-47965, A-47966, A-48231, A-48849, A-48946, A-49852, A-49886, A-49924, A-50013, A-50018, A-50381, A-50938, A-50961, A-51100, A-51102, A-51137, A-51282, A-52508, A-52741, A-52912, A-53295, A-53751, A-53955, A-54622, A-55212, A-55407, A-55601, A-55922, A-56192, A-58939, A-59494, A-59775, A-60727, A-60728, A-60866, A-61007, A-61154, A-61183, A-61800, A-63661, A-64926, A-66977, A-67940, A-68703,

A-68807, A-69039, A-69309, A-69422, A-70727, A-71477, A-71615, A-72079, A-72133, A-74154, A-74262, A-76411, A-76638, A-76644, A-77367, A-79511, A-80334, A-80507, A-80994, A-81169, A-81343, A-82192, A-83637, A-84479, B-02541, B-04368, B-04794, B-07664, B-10372, B-10618, B-13676, B-13771, B-14692, B-15322, B-15372, B-17463, B-18536, B-18641, B-18698, B-18699, B-19571, B-20436, B-21795, B-23310, B-24033, B-24683, B-25178, B-25195, B-25638, B-26279, B-26317, B-26908, B-27569, B-28320, B-28502, B-28709, B-29725, B-30276, B-30519, B-32384, B-32461, B-32712, B-33620, B-35111, B-35513, B-36716, B-37115, B-37293, B-37402, B-37509, B-37536, B-37544, B-37603, B-37745, B-38188, B-38439, B-38445, B-38476, B-38587, B-38593, B-38775, B-38874, B-40381, B-40414, B-40712, B-40892, B-41378, B-41569, B-41932, B-42078, B-42104, B-42172, B-42287, B-43108, B-44716, B-45254, B-45380, B-45468, B-45544, B-45846, B-46086, B-47095, B-47463, B-47466, B-47821, B-48143, B-48805, B-48811, B-48814, B-49023, B-49477, B-49979, B-50154, B-50937, B-51101, B-51755, B-51845, B-52172, B-52179, B-53620, B-54310, B-55524, B-55678, B-56078, B-56528, B-56591, B-58632, B-59845, B-60849, B-60864, B-61259, B-63540, B-63775, B-63784, B-64428, B-64506, B-64696, B-65638, B-66592, B-66618, B-66947, B-67217, B-67700, B-67742, B-67846, B-67954, B-68795, B-69528, B-70428, B-70537, B-71297, B-71623, B-71796, B-74480, B-74483, B-77816, B-78814, B-78890, B-79657, B-79711, B-80356, B-80500, B-80863, B-81256, B-81995, B-83134, B-83667, C-00126, C-00260, C-00264, C-00941, C-01313, C-01349, C-01593, C-01793, C-02042, C-02565, C-02681, C-03119, C-04105, C-04405, C-04463, C-05620, C-06962, C-09983, C-10632, C-11574, C-11626, C-11915, C-13056, C-16801, C-17082, C-17092, C-17098, C-17117, C-18283, C-20030, C-20595, C-21156, C-21730, C-21881, C-22458, C-22877, C-23575, C-24222, C-24970, C-25223, C-25474, C-26203, C-26729, C-27130, C-27131, C-27769, C-27962, C-28374, C-28441, C-28462, C-29426, C-29737, C-29738, C-29887, C-30007, C-30014, C-30300, C-30432, C-30793, C-30958, C-32450, C-32631, C-32643, C-33632, C-33929, C-34125, C-34126, C-35441, C-36125, C-36771, C-36800, C-37350, C-37579, C-37799, C-38278, C-38280, C-38741, C-39008, C-39762, C-40705, C-41020, C-41063, C-41064, C-41624, C-42375, C-43570, C-44083, C-44174, C-44177, C-44689, C-45344, C-45760, C-46303, C-46443, C-46784, C-48392, C-49391, C-49476, C-49879, C-49992, C-51551, C-52101, C-52206, C-52992, C-55367, C-55858, C-55923, C-56244, C-56572, C-56865, C-57079, C-58278, C-59049, C-60010, C-61103, C-61692, C-61859, C-61993, C-61995, C-63848, C-64090, C-65118, C-65846, C-66606, C-67528, C-68944, C-69526, C-69668, C-69675, C-70686, C-72017, C-73471, C-74354, C-76030, C-76212, C-77427, C-78426, C-79032, C-79835, C-80573, C-81357, C-82273, C-82552, C-83495, C-84471, D-01872, D-06809, D-07579, D-10619, D-13838, D-14066, D-17102, D-17642, D-18537, D-19145, D-19966, D-21419, D-22348, D-22359, D-23392, D-23862, D-25093, D-25593, D-28097, D-29040, D-30705, D-31396, D-32666, D-33309, D-34008, D-37607, D-37823, D-39182, D-40896, D-43170, D-44799, D-47982, D-50690, D-52811, D-58218, D-60574, D-63186, D-73286, D-78442, E-02325, E-14897, E-29023, E-29910, E-37013, E-37639, E-44277, E-59075, E-59234, E-64013, E-76047, E-78943, F-01677, F-02337, F-02517, F-03062, F-14907, F-15927, F-16218, F-19175, F-21632, F-22219, F-28428, F-39861, F-41543, F-55415, F-57581, F-68048, F-78035, G-01047, G-01096, G-01426, G-01728, G-01794, G-02539, G-03394, G-04145, G-04734, G-06675, G-07098, G-07344, G-08201, G-10203, G-10247, G-10333, G-10362, G-10842, G-11444, G-11467, G-11942, G-11945, G-12282, G-12987, G-13215, G-13700, G-14112, G-14126, G-14319, G-14477, G-15040, G-16047, G-16345, G-18785, G-18809, G-18987, G-19880, G-24392, G-24494, G-26274, G-28556, G-30145, G-30788, G-31234, G-31319, G-32152, G-32256, G-32596, G-32601, G-32605, G-32606, G-32607, G-33510, G-33511, G-33561, G-33766, G-34398, G-34861, G-35670, G-36411, G-36723, G-37139, G-37282, G-37569, G-37684, G-38616, G-39219, G-39494, G-39497, G-39799, G-39810, G-39813, G-39924, G-39931, G-40597, G-40635, G-41224, G-41685, G-41686, G-41687, G-41706, G-43636, G-43896, G-44362, G-44590, G-45055, G-46085, G-47807, G-48030, G-48068, G-49448, G-50161, G-51473, G-52147, G-52557, G-52686, G-54302, G-54968, G-55517, G-56538, G-57024, G-57299, G-59073, G-60625, G-60748, G-62596, G-66668, G-67440, G-68583, G-70519, G-71617, G-72083, G-74290, G-79848, G-79980, G-80078, G-80197, G-81250, G-84137, G-84233, G-84236, G-84260, H-00137, H-00187, H-00240, H-00265, H-00266, H-00301, H-00631, H-00633, H-01092, H-01800, H-02041, H-02049, H-02379, H-02382, H-03116, H-03549, H-03570, H-03571, H-03572, H-03612, H-03613, H-03616, H-03860, H-03873, H-04816, H-10841, H-10843, H-11157, H-11452, H-11456, H-11466, H-11469, H-11650, H-13159, H-13203, H-13213, H-13804, H-14678, H-15604, H-15838, H-16092, H-16150, H-16152, H-16222, H-16244, H-16567, H-16673, H-17163, H-17449, H-17822, H-17892, H-18226, H-18265, H-18266, H-18267, H-18270, H-18272, H-18319, H-18507, H-19539, H-19604, H-19703, H-19873, H-19949, H-20476, H-20872, H-20917, H-21062, H-21422, H-22496, H-22624, H-22930, H-23188, H-23214, H-23295, H-23386, H-23576, H-23579, H-23580, H-23624, H-23639, H-23661, H-23852, H-23874, H-23950, H-23986, H-24024, H-24035, H-24036, H-24064, H-24330, H-24366, H-24395, H-24533, H-24787, H-24933, H-25099, H-25366, H-25661, H-25665, H-25750, H-26175, H-26491, H-26978, H-27021, H-27091, H-27785, H-28409, H-28427, H-28437, H-28443, H-28474, H-28475, H-28476, H-28477, H-28479, H-28483, H-28600, H-28802, H-29277, H-29736, H-29991, H-30142, H-30225, H-30297, H-30298, H-30299, H-30301, H-31208, H-31733, H-32280, H-32282, H-32286, H-32289, H-32291, H-32334, H-32339, H-32343, H-32344, H-32516, H-32535, H-32536, H-32539, H-32588, H-32672, H-32673, H-32854, H-32897, H-32982, H-33606, H-33806, H-34880, H-35877, H-35880, H-35992, H-36159, H-36742, H-36785, H-36994, H-36996, H-36998, H-37346, H-37480, H-37567, H-38017, H-38332, H-38412, H-38574, H-39159, H-39183, H-39190, H-39328, H-39466, H-39493, H-39537, H-39607, H-39627, H-39684, H-39782, H-39887, H-39895, H-39902, H-39923, H-39932, H-40341, H-40368, H-40460, H-40472, H-40599, H-40916, H-41189, H-41362, H-41370, H-41439, H-41482, H-41696, H-41698, H-41699, H-42954, H-43492, H-43493, H-43663, H-44411, H-44428, H-45007, H-45022, H-45160, H-45214, H-45345, H-45467, H-45474, H-45781, H-46338, H-46557, H-46719, H-46721, H-46733, H-46923, H-46997, H-47014, H-47286, H-47806, H-48022, H-48167, H-48193, H-48413, H-48798, H-49316, H-49561, H-49644, H-49647, H-50677, H-50729, H-50959, H-51271, H-51470, H-52574, H-52705, H-52964, H-53376, H-54297, H-54755, H-55654, H-56428, H-56584, H-56874, H-56885, H-56963, H-57475, H-57716, H-58381, H-58506, H-59947, H-60595, H-60913, H-60957, H-60961, H-61000, H-61496, H-62597, H-63167, H-63442, H-64166, H-64427, H-64860, H-65103, H-66035, H-66798, H-66983, H-67480, H-68122, H-68575, H-69596, H-70607, H-72132, H-73172, H-73518, H-74617, H-74626, H-75027, H-76297, H-77377, H-78402, H-79129, H-80189, H-80536, H-81771, H-83082, H-84290, H-84477, H-84484, I-00085, I-24308, I-40833, I-46606, I-47291, I-52320, I-54961, I-56143, I-63871, I-73616, J-29923, J-30226, J-38409, J-41121, J-48171, K-03032, K-10168, K-11414, K-27010, K-28466, K-41266, K-41267, K-41295, K-41682, K-47672, K-58638, K-60180, K-68582, K-78880, L-06754, L-17472, L-17614, L-19434, L-25427, L-25542, L-31492, L-32354, L-38573, L-39306, L-39749, L-40461, L-40889, L-41455, L-42810, L-42873, L-42874, L-44054, L-44598, L-46561, L-46586, L-48719, L-60630, L-67888, L-76397, L-77817, L-78484, L-80894, L-83965, N-04212, N-14783, N-16400, N-17260, N-21287, N-32254, N-37027, N-46820, N-49170, N-51942, N-63776, N-64545, N-65407, N-69692

EVAPORATORS A-21380, B-26674, B-39104, B-64898, F-44721

EXCESS AIR A-11590, A-33853, A-46925, A-60866, A-64926, B-18826, B-33554

EXCRETIONS A-00220, A-00375, A-01687, A-02312, A-02653, A-02988, A-03450, A-17116, A-17405, B-02541, C-00126, C-00260, C-00264, C-00626, C-00636, C-00941, C-01349, C-01793, C-03503, C-18264, C-26744, C-43570, C-47193, C-60410, C-77492, D-47982,

F-07714, F-34948, G-01338, G-01674, G-01728, G-01794, G-04983, G-06485, G-06497, G-10203, G-10842, G-12987, G-13700, G-14112, G-14126, G-14477, G-19880, G-23563, G-24126, G-24392, G-24720, G-26461, G-26846, G-26873, G-27753, G-27755, G-28037, G-28556, G-28754, G-29415, G-29807, G-31234, G-32601, G-32606, G-33505, G-33511, G-33766, G-33872, G-36751, G-36947, G-37569, G-37684, G-38106, G-38942, G-40920, G-44362, G-44590, G-44593, G-44594, G-47905, G-48636, G-48637, G-49164, G-49607, G-50318, G-50371, G-50419, G-52686, G-54302, G-56931, G-61646, G-62177, G-62596, G-71324, G-74380, G-74821, G-74822, G-76902, G-79619, G-79623, G-79634, G-79796, G-81181, G-83177, G-83798, G-84266, H-00187, H-00240, H-00265, H-00266, H-00301, H-00600, H-00631, H-00633, H-00654, H-00788, H-00920, H-00944, H-00964, H-00979, H-01092, H-01250, H-01398, H-01506, H-01557, H-01664, H-01705, H-01800, H-01809, H-02041, H-02049, H-02200, H-02379, H-02382, H-02537, H-03116, H-03360, H-03395, H-03472, H-03549, H-03570, H-03571, H-03572, H-03611, H-03612, H-03613, H-03616, H-03629, H-03676, H-03729, H-03860, H-03873, H-04816, H-04919, H-04923, H-04924, H-04997, H-05004, H-05612, H-06353, H-06354, H-10841, H-10843, H-12554, H-18268, H-18269, H-18270, H-20015, H-20707, H-25735, H-26734, H-26742, H-28031, H-28035, H-32736, H-39493, H-40201, H-40368, H-44428, H-46997, H-48167, H-48193, H-49434, H-65103, K-03582

EXHAUST SYSTEMS A-01687, A-04068, A-08102, A-08748, A-09799, A-31283, A-40180, A-42751, A-44490, A-53874, A-60866, A-68807, A-71477, B-04368, B-07664, B-08344, B-24116, B-25523, B-28786, B-32627, B-35513, B-38082, B-42078, B-42104, B-47125, B-47256, B-49477, B-52179, B-70428, B-72038, B-80213, C-01313, D-06809, D-37823, H-26711, I-39031, J-39910

EXPERIMENTAL EQUIPMENT A-74586, C-04691, C-05317, C-11404, C-11626, C-12100, C-24399, C-48916, C-58842, C-59814, F-55415, H-06459, H-18770, H-26711, H-37792

EXPLOSIONS A-32576, A-39862, B-38775, B-41839, C-44253, G-43323

EXPOSURE CHAMBERS A-11916, A-31333, B-04853, C-00941, C-07719, C-09770, C-23947, F-52013, F-55415, G-01096, G-01426, G-02539, G-07013, G-08031, G-21455, G-30841, G-41224, H-00631, H-00788, H-00920, H-02200, H-03549, H-03571, H-03729, H-03860, H-04678, H-04679, H-04688, H-04732, H-05324, H-07047, H-16399, H-16894, H-16900, H-23516, H-26711, H-28479, H-30298, H-30299, H-31448, H-31527, H-32282, H-32516, H-33606, H-39782, H-40460, H-41362, H-45009, H-56241, H-56625, H-64166, I-08076

EXPOSURE METHODS A-11916, C-04691, C-07710, C-07719, C-36800, C-38278, G-01047, G-01096, G-01426, G-04983, G-07917, G-10362, G-18809, G-24126, G-25160, G-27379, G-28041, G-32596, G-32601, G-32606, G-33510, G-33511, G-33561, G-35569, G-36411, G-39799, G-39810, G-39813, G-41036, G-41224, G-49223, G-52147, G-52686, G-57024, H-00187, H-00301, H-00633, H-03572, H-03860, H-03873, H-04688, H-04732, H-04917, H-04918, H-04923, H-04924, H-04925, H-04984, H-05004, H-05398, H-05399, H-05560, H-06404, H-07255, H-09683, H-10150, H-11407, H-15213, H-16150, H-16152, H-18704, H-18770, H-21422, H-23516, H-24402, H-25230, H-26717, H-28427, H-28479, H-28480, H-31448, H-32854, H-37792, H-39607, H-39782, H-39902, H-39986, H-40460, H-40899, H-42907, H-43663, H-46557, H-46719, H-46923, H-48403, H-48798, H-49434, H-51905, H-52306, H-54910, H-56204, H-56241, H-56515, H-56625, H-62548, H-63442, H-65558, H-71931, H-74588, H-78058, H-78402, H-79129, H-81495, I-00695

EXTERNAL COMBUSTION ENGINES B-75138

EYE IRRITATION A-00375, A-13699, A-28038, B-18144, E-29774, G-06288, G-06485, G-07917, G-08031, G-11942, G-19148, G-23003, G-26461, G-28199, G-30841, G-35569, G-40597, G-48068, G-60228, G-83177, K-31968, N-28923

EYES G-07344, G-11942, G-16874, G-18987, G-33509, G-33511, G-35569, G-35670, G-41684, G-41686, G-41687, G-41688, G-44594, G-48068, G-49223

F

FABRIC FILTERS A-08102, A-09799, A-12740, A-15452, A-17076, A-40344, A-41650, A-41877, A-43270, A-44490, A-48429, A-60827, A-70069, A-76152, A-76190, A-81861, B-07815, B-10618, B-19487, B-21795, B-22484, B-22853, B-25135, B-28786, B-29680, B-30519, B-31567, B-36755, B-38115, B-43299, B-44638, B-45380, B-45544, B-45707, B-45757, B-47256, B-47677, B-47680, B-48814, B-49023, B-49477, B-52172, B-52179, B-58879, B-61935, B-63474, B-63775, B-64977, B-65640, B-66624, B-70658, B-70840, B-71796, B-77475, B-80213, B-81773, C-24118, C-35956, C-81439, K-33107, L-32884, L-38573

FADING D-09590, D-26086

FALLOUT A-37996, D-07579, G-03394, H-42857

FANS (BLOWERS) A-01687, A-08748, A-09799, B-25523, B-32627, B-42078, B-42104, B-47256, P-49477, B-72038, C-01313

FARMS B-26911, C-18344, C-60410, G-26846, G-38942, G-84266, H-00737, H-10711, H-19604, H-20157, H-20707, H-20708, H-24282, H-32672, H-36994, H-42601, H-43226, H-51754, H-60760, H-65103, H-66983, H-68394, H-73518, H-74588, H-80064, J-32706, J-60298, J-67865, L-06349, L-24010, L-25642, N-12307

FAT AND OIL PRODUCTION A-09785, A-22973, A-71262, L-09677

FEASIBILITY STUDIES B-41932, B-43863, B-47731, L-42810

FEEDLOTS A-00340, A-03129, A-05090, A-12631, A-37190, A-39587, A-47959, A-71262, B-06587, B-08344, B-09664, B-18144, B-24117, B-25038, G-06497, G-10842, H-08884, H-21062, H-23624, H-23661, H-23976, H-24282, H-24366, H-25499, H-32536, H-32539, H-33606, H-36998, H-37567, H-39923, H-43226, H-50415, L-37747, L-37943

FEES L-31492, L-32173, L-32245, L-32272

FERROALLOYS A-39460, A-42680, A-47962, B-48811, B-60864, I-65935

FIBER GLASS PRODUCTION C-84463

FIELD OPERATIONS B-76232, B-81772, B-81773

FIELD TESTS A-31333, A-67748, A-67834, B-10618, C-00260, C-01793, C-12593, C-18344, C-22879, C-28530, C-39288, C-40409, C-60278, C-74234, C-75058, C-81439, D-66083, G-27379, H-04678, H-16896, H-18268, H-18272, H-18704, H-18770, H-25099, H-26861, H-28479, H-28480, H-60595, H-67347, I-00695

FILTER FABRICS A-00896, A-06371, A-08816, A-11877, A-12470, A-26254, A-30296, A-31134, A-31144, A-33853, A-41650, A-42751, A-43014, A-43272, A-47963, A-48429, A-60866, A-63661, A-71262, B-05567, B-08344, B-18144, B-19177, B-19210, B-24110, B-26745, B-28320, B-29680, B-35513, B-38115, B-44979, B-45078, B-45544, B-45707, B-46050, B-49023, B-55046, B-63784, B-64070, B-66947, B-70840, B-74483, B-77475, C-03527, C-04038, C-04560, C-07871, C-12334, C-12593, C-18264, C-22517, C-22812, C-24118, C-25487, C-26209, C-30300, C-32450, C-34125, C-35956, C-39022, C-39288, C-41067, C-48916, C-60278, C-60410, C-70636, D-09590, D-25093, D-52578, D-66083, E-33579, H-02200, H-11436, H-35880, H-38017, H-38412, H-39537, I-07553, J-39910, K-66860, L-38573

FILTERS A-00340, A-00896, A-06371, A-08102, A-08816, A-09799, A-11877, A-12470, A-12474, A-12692, A-12740, A-12813, A-15452, A-17076, A-20134, A-26254, A-30296, A-31134, A-31144, A-33853, A-40159, A-40180, A-40344, A-41650, A-41877, A-42751, A-43014, A-43270, A-43272, A-44490, A-47962, A-47963, A-48429, A-60827, A-60866, A-63661, A-70069, A-71262, A-76152, A-76190, A-81861, A-82192, B-04368, B-05567, B-07552, B-07815, B-08344, B-09773, B-10618, B-11686, B-18144, B-19177, B-19210, B-19487, B-21795, B-22484, B-22853, B-22943, B-24110, B-25135, B-26745, B-28320, B-28502, B-28786, B-29680, B-29725, B-30519, B-31567, B-33191, B-35106, B-35448, B-35513, B-36552, B-36755, B-37745, B-38115, B-38439, B-42083, B-42104, B-43299, B-44638, B-44979, B-45078, B-45380, B-45468, B-45544, B-45707, B-45757, B-46050, B-47256, B-47341, B-47677, B-47680, B-48480, B-48814, B-49023, B-49477, B-49979, B-52172, B-52179, B-55046, B-55524, B-58879, B-60282, B-61935, B-62786, B-63474, B-63775, B-63784, B-64070, B-64977, B-65640, B-66624, B-66947, B-67742, B-70428, B-70537, B-70658, B-70840, B-71796, B-74483, B-77475, B-80213, B-81773, B-84418, C-01593, C-02681, C-03527, C-04038, C-04540, C-06112,

C-07710, C-07871, C-10632, C-11404, C-12334, C-12593, C-[illegible]264, C-19500, C-2180[illegible], C-22517, C-22812, C-23947, C-24118, C-24372, C-25180, C-25487, C-25[illegible]6, C-26209, C-27044, C-28285, C-[illegible]374, C-28738, C-29426, C-29738, C-[illegible]9771, C-29857, C-30300, C-30432, C-32450, C-[illegible]3711, C-34125, C-35108, C-[illegible]5956, C-38741, C-38905, C-39022, [illegible]268, C-41020, C-41064, C-41491, C-44552, C-48916, C-53876, C-55858, C-60278, C-60410, C-60951, C-61103, C-68086, C-70638, C-81439, D-09590, D-25093, D-28097, D-37502, D-52578, D-58339, D-61140, D-66083, E-33579, F-55415, H-00265, H-02200, H-[illegible]1456, H-21364, H-32897, H-33468, H [illegible] H-38017, H-38412, H-39537, H-[illegible] H-42601, H-61496, I-07553, J-39910, J-76213, K-33107, K-66860, L-32884, L-38573, N-46820

FINLAND D-78442, H-81771, K-68582

FIR TREES H-83082

FIRING METHODS A-11590, A-17377, A-33853, A-37562, A-46925, A-47048, A-48231, A-49852, A-50381, A-60281, A-60866, A-64926, B-07664, B-18826, B-26911, B-29680, B-33554, B-42172, B-43840, B-59230, B-60282, B-61259, B-62165, B-65640, B-71796, B-77838, H-00301, N-54545, N-64937

FLAME AFTERBURNERS A-47963, B-76512

FLAME IONIZATION (HC) C-83495

FLAME IONIZATION DETECTOR (CO) C-02681, C-06112, C-11574, C-2[illegible]4, C-29198, C-35956, C-36125, C-39719, C-41020, C-41719, C-43979, C-46034, C-47218, C-48492, C-48916, C-49752, C-49879, C-51762, C-58278, C-61859, C-66753, H-42907

FLAME PHOTOMETRY C-80573, C-82650

FLAMES C-83495

FLARES B-45707, B-49031

FLAX C-03478, G-03246, H-03729

FLORIDA A-00220, A-00340, A-02019, A-03450, A-12095, B-07190, B-09664, D-09658, D-24801, D-28188, E-37037, H-01705, H-06404, H-16896, H-28830, H-28899, H-37403, H-44345, H-53370, H-59935, L-06938, L-06939, L-[illegible]577

FLOWERS A-12095, A-83543, B-02541, B-28889, C-00626, C-00941, C-04757, C-26909, D-09590, D-37473, E-37037, E-76047, G-05504, G-81181, H-00631, H-00964, H-00979, H-01506, H-01705, H-01800, H-02049, H-02537, H-03395, H-03613, H-03616, H-03766, H-04678, H-04679, H-04732, H-04984, H-05324, H-05724, H-06404, H-06557, H-07047, H-08884, H-10342, H-10673, H-11466, H-12042, H-14121, H-16222, H-16387, H-16472, H-16894, H-17163, H-17449, H-17710, H-17822, H-18272, H-18704, H-21364, H-21687, H-22499, H-22887, H-23986, H-24036, H-24566, H-25273, H-25499, H-26800, H-28480, H-29443, H-29597, H-30298, H-30299, H-30806, H-31448, H-32280, H-32282, H-32339, H-32343, H-32714, H-33089, H-36787, H-37346, H-37403, H-41439, H-41699, H-42958, H-46051, H-48291, H-48556, H-52574, H-56240, H-57475, H-60560, H-61410, H-70745, H-70752, H-74721, H-74722, H-79309, H-79635, H-80067, H-80083, H-80085, H-82146, H-82435, H-83721, H-83723, H-83730, H-84553, H-84651, J-43547, J-55161, K-07605, K-26738, L-06754

FLOWMETERS C-01349, C-08077, C-09770, C-31712, C-35108, C-35956, G-01096, H-18770

FLUID FLOW A-05090, A-09214, A-09321, A-09332, A-11541, A-31283, A-31581, A-40344, A-43816, A-45858, A-48231, B-08344, B-18830, B-24110, B-26745, B-29403, B-30276, B-33971, B-37544, B-38299, B-38874, B-40414, B-44716, B-48480, B-48814, C-01349, C-04405, C-08077, C-21806, C-22879, C-35956, C-41064, C-44689, C-46784, C-48674, E-33092, E-43855, E-79132, G-01096, H-00631, H-26711, H-31527

FLUIDIZED BED PROCESSING B-77838, B-78814, B-81995, B-83134, C-81439

FLUIDIZED BED SCRUBBERS B-80356

FLUORANTHENES C-26707, C-27294

FLUORESCENCE A-00375, A-42731, A-50013, C-01313, C-07763, C-11779, C-24118, C-24124, C-24315, C-24372, C-26122, C-26396, C-27131, C-27248, C-27331, C-28671, C-42375, C-43979, C-43985, C-43986, C-47096, C-47218, C-48916, C-49879, C-50337, C-53523, C-66753, C-67116, C-83495, D-33309, D-52578, F-46162, F-78035, H-03571

FLUORINATED HYDROCARBONS A-08486, A-23022, A-30296, A-48572, A-49738, B-41839, B-68201, C-00264, C-08077, C-10632, C-20701, C-23654, C-25441, C-79843, C-83592, E-77970, F-01677, F-02517, F-03062, F-53153, F-68048, F-69599, G-01426, G-08702, G-12403, G-24720, G-30145, G-30841, G-45683, H-42907, H-56213, H-59198

FLY ASH A-11453, A-11876, A-15452, A-22875, A-29519, A-32139, A-32576, A-32702, A-39460, A-40344, A-46925, A-48231, A-50013, A-52508, A-53751, A-57231, A-60727, A-61800, A-68703, A-75077, A-75089, A-81343, B-05567, B-07552, B-19177, B-25038, B-26908, B-32232, B-36552, B-41378, B-43863, B-45707, B-59230, B-74480, B-77838, C-44710, C-53523, C-75339, D-09590, E-29774, F-44721, G-11467, G-24392, G-26274, G-39494, G-73658, H-04816, H-11157, H-12554, H-18270, H-19539, H-23624, H-24366, H-35992, H-36742, H-36998, H-38332, H-41696, H-42086, H-44295, H-48374, H-70487, L-09677

FOG A-00220, A-46119, A-79511, C-48392, C-51599, D-23862, D-40896, E-14897, G-12555, G-18987, G-32607, G-39219, G-40597, H-23295, H-28149, H-51470, N-04212, N-66750

FOOD G-84266, H-80079

FOOD AND KINDRED PRODUCTS INDUSTRY A-02312, A-09214, A-09785, A-11541, A-22973, A-26254, A-30517, A-32855, A-34018, A-37996, A-39460, A-40159, A-40344, A-43270, A-45858, A-47963, A-66977, A-71262, A-77367, A-80334, B-26911, B-44716, D-49860, H-09553, H-24330, H-39537, H-66983, J-30696, J-48171, J-67865, K-10168, L-09677, L-37747, L-37943

FORESTS A-37190, C-11915, C-27130, C-56865, D-44799, H-00737, H-16673, H-18507, H-21062, H-24933, H-25769, H-26158, H-28479, H-32334, H-32344, H-32516, H-32672, H-36998, H-38411, H-38412, H-38574, H-39183, H-39190, H-39466, H-39684, H-40341, H-40599, H-41362, H-41370, H-41482, H-41696, H-41698, H-42954, H-45160, H-45467, H-45604, H-46217, H-47286, H-48022, H-52829, H-52994, H-54297, H-56637, H-56874, H-56885, H-58381, H-58506, H-59028, H-60957, H-64860, H-66983, H-73172, H-73518, H-74617, H-76715, H-81771, H-82498, J-38409, J-67865, L-41455, N-66718

FORMALDEHYDES A-23561, A-32855, A-61570, B-62165, C-09983, C-12451, C-15171, C-20650, C-22812, C-26707, C-27294, C-31115, C-32476, C-38670, C-39719, C-43985, C-50337, C-59513, C-65118, C-67116, C-80259, D-31371, D-34008, D-50690, D-60574, D-63186, F-68048, G-01794, H-52928, I-00695, L-29504, L-81220

FORMIC ACID A-37190, I-40510

FRACTIONATION A-24370, E-30126

FRANCE A-11453, A-17357, A-37996, A-46119, A-70727, A-74154, B-02541, B-20436, B-28502, B-32712, B-35111, B-45544, B-45846, B-52172, B-63784, C-13056, C-21881, C-22458, C-28441, C-28462, C-32643, C-35441, C-44689, C-45344, C-61692, C-70686, C-79032, C-80573, C-81357, D-39182, E-14897, F-28428, F-41543, G-07344, G-16047, G-30788, G-32607, G-34398, G-34861, G-41706, G-43636, G-46085, G-49448, G-74290, G-80197, G-81250, G-84236, H-11469, H-13159, H-13804, H-15604, H-16567, H-17892, H-23386, H-23852, H-27785, H-28443, H-28476, H-28600, H-29991, H-39183, H-39627, H-39684, H-44411, H-46997, H-48413, H-51271, H-51470, H-60595, H-62597, H-74617, H-80536, H-83082, I-54961, K-68582, L-42810, L-44054, L-44598, L-46586, L-60630, N-17260, N-64545

FREE RADICALS E-29774, F-02517, F-53153

FREEZING C-29771, C-35956

FRUITS A-03450, A-12095, A-13701, A-26329, B-02541, B-04853, B-09664, C-01349, C-04757, C-05892, C-18230, C-20540, C-28441, C-28452, D-28188, D-71272, D-77485, E-37037, G-01338, G-01674, G-11444, G-13700, G-81250, H-00301, H-01664, H-01800, H-01809, H-02379, H-03116, H-03395, H-03611, H-03616, H-03629, H-03766, H-03860, H-03873, H-04403, H-04672, H-04732, H-04984, H-05667, H-06404, H-06459, H-06557, H-07255, H-10342, H-10673, H-11407, H-11456, H-11466, H-13203, H-15604, H-16385, H-16896, H-17109, H-17892, H-18226, H-18266, H-18770, H-19147, H-19358, H-20573, H-20872, H-21093, H-21687, H-22084, H-22085, H-22092, H-22284, H-23516, H-23874, H-23950, H-23986, H-24358, H-27030, H-27303, H-28446, H-28476, H-28830, H-28899, H-30142, H-30225, H-30805, H-31124, H-31208, H-31448, H-31733, H-32339, H-32535, H-32536, H-32539, H-33468, H-33716, H-35578, H-35880, H-37346, H-37403, H-40202, H-40368, H-41439, H-42958, H-43492, H-44345, H-46051, H-47286, H-47806, H-50157, H-52698, H-53370, H-54066, H-54910, H-55066, H-57475, H-58777, H-59935,

H-60907, H-64824, H-74588, H-74721, H-74722, H-76838, H-77050, H-79309, H-80067, H-80079, H-80085, H-80493, H-80575, H-82146, H-82435, H-82520, H-83145, H-83182, H-83258, H-83849, H-83856, H-84080, H-84089, H-84527, H-84541, H-84545, J-28805, J-43002, K-07605, K-26738, L-44598
FUEL ADDITIVES A-27595, A-29786, A-47959, B-02541, B-29680, B-35106, B-37164, B-65640, C-27248, C-55858, C-61692, G-44867, K-19818, L-60630
FUEL CHARACTERISTICS A-53751, A-57231, A-59257, A-61800, A-73078, A-76638, A-81343, B-60849, B-75387, B-79079, B-80950
FUEL CHARGING A-17377
FUEL CRITERIA K-46081
FUEL EVAPORATION A-34018, B-49031, L-09677
FUEL GASES A-00896, A-04068, A-09785, A-09799, A-12557, A-22875, A-32060, A-40344, A-40401, A-41877, A-45858, A-46925, A-47188, A-47410, A-48849, A-59775, A-61007, A-66977, A-69353, B-18826, B-19177, B-35111, B-44793, B-60849, B-60864, B-71796, B-79711, C-22812, D-09590, E-14897, G-36751, H-08884, K-34063, L-24122, L-32884, L-35795, L-47380
FUEL OIL PREPARATION A-46925, A-61154, B-26908, B-35106, B-38299, B-38476, B-51845, B-60849, D-47976, L-42873
FUEL OILS A-09785, A-09799, A-12557, A-29519, A-29786, A-31144, A-31315, A-32060, A-40344, A-40401, A-41877, A-42685, A-45858, A-46925, A-47188, A-47410, A-48849, A-49852, A-56192, A-59257, A-59494, A-61007, A-61154, A-75077, B-19177, B-26908, B-35106, B-38299, B-60255, B-60849, B-61935, B-71796, C-22812, C-35108, C-53523, C-61851, C-75339, D-09590, D-33108, D-39054, D-39737, D-40896, E-59234, G-32607, G-44597, G-71933, H-01398, H-40368, H-67026, I-07553, J-30226, K-10168, K-31968, K-34063, L-25427, L-29421, L-29598, L-32884, L-37747, L-44054, L-47380, L-60630, N-04212
FUEL RESOURCES A-53751, A-59257, G-73658
FUEL STANDARDS K-33107, K-46081, K-47672, L-32173, L-32245, L-32272, L-32884, L-35795, L-42873, L-44054, L-48719
FUEL TANK EVAPORATION B-49031
FUEL TREATMENT A-32519, A-42675, A-46925, A-47965, A-57231, A-61154, A-77367, B-26908, B-35106, B-38299, B-38476, B-51845, B-60849, B-65638, B-67700, B-75204, D-35764, D-47976, E-14897, F-44721, H-39537, L-42873, N-50867, N-64545
FUEL USAGE J-76213
FUMES A-01125, A-01528, A-01687, A-03129, A-05601, A-06241, A-06371, A-09785, A-09799, A-15452, A-17377, A-18656, A-27314, A-27930, A-31283, A-32702, A-36377, A-40180, A-40344, A-41877, A-42751, A-44490, A-44605, A-74586, A-79567, A-82279, B-07190, B-07549, B-07552, B-07664, B-07815, B-09773, B-10618, B-19177, B-22853, B-24116, B-25433, B-25590, B-26244, B-26745, B-28783, B-28786, B-30814, B-32712, B-35513, B-36755, B-38115, B-41418, B-43533, B-44979, B-45707, B-47256, B-47341, B-48805, B-49023, B-52094, B-52172, B-52179, B-57706, B-58879, B-64092, B-70428, B-70658, B-70840, B-71412, C-16801, C-18230, C-52206, C-81439, D-06809, D-39737, G-04145, G-06485, G-08702, G-11467, G-18809, G-18988, G-27379, G-28139, G-30788, G-38721, G-40527, G-52638, H-03676, H-19949, H-28480, H-36998, H-42857, H-42954, H-43663, H-49644, H-56874, H-56885, H-64860, I-39031, L-09677, L-24010, L-29818, L-32173, L-32245, L-32272
FUNGI A-00375, C-43981, G-01794, G-07098, G-30788, G-61467, H-00137, H-12042, H-32334, H-33127, H-40341, H-46338, H-56241, H-62275, H-67348, H-80575, I-07553
FURNACES A-00375, A-00896, A-01528, A-03450, A-08102, A-09693, A-09799, A-12622, A-12740, A-17344, A-26254, A-27617, A-29532, A-31144, A-32139, A-32702, A-33853, A-34018, A-40180, A-41650, A-41877, A-42682, A-42683, A-42751, A-43014, A-45858, A-47962, A-49617, A-52912, A-59775, A-60866, A-61154, A-61800, A-64926, A-72125, A-76644, A-77522, B-02962, B-04794, B-05567, B-06587, B-07664, B-10372, B-10618, B-18830, B-19177, B-23182, B-23370, B-24683, B-25038, B-25433, B-25638, B-29680, B-31567, B-32461, B-32627, B-33554, B-35111, B-37293, B-38115, B-38476, B-40892, B-42172, B-43108, B-43481, B-44979, B-45380, B-45544, B-45757, B-47125, B-47341, B-47821, B-48814, B-49023, B-50652, B-56528, B-58879, B-58993, B-59230, B-61935, B-64506, B-64977, B-70658, B-70659, B-75387, B-82918, C-17098, C-26729, C-32643, C-35956, C-82650, D-37823, D-39737, D-43317, E-59075, F-39861, G-31234, H-19656, H-27324, H-29736, H-83258, K-31968, K-34063, K-36823, K-51212, K-51229, K-58899, K-72151, L-09677, L-29598, L-30620, L-32789, L-38573, L-48788, L-73839, L-81399, N-32254

G

GAMMA RADIATION A-59921, C-17117, C-50093, D-30058, D-56463, F-69599, G-07961, H-50503, H-50505
GAS CHROMATOGRAPHY A-22875, A-31529, A-48116, A-49738, C-02681, C-06112, C-06352, C-07719, C-11574, C-18696, C-20701, C-22877, C-25441, C-28126, C-29198, C-30014, C-32534, C-35956, C-36125, C-38670, C-39719, C-41020, C-41063, C-41719, C-43979, C-46034, C-47218, C-48492, C-48916, C-49391, C-49752, C-49879, C-50936, C-51762, C-52629, C-55789, C-57079, C-58278, C-60010, C-60553, C-61859, C-74221, C-74346, C-79032, C-80495, C-80573, C-82650, C-83495, D-31371, D-33080, E-33579, F-02517, G-01426, G-08031, H-02382, H-42907
GAS SAMPLING A-03565, A-06371, A-08748, A-09214, A-09321, A-09332, A-09541, A-09695, A-11341, A-11590, A-11876, A-11877, A-12470, A-12474, A-12587, A-12676, A-12692, A-12740, A-12741, A-17773, A-12809, A-12889, A-12919, A-12933, A-13353, A-43816, B-56064, C-00450, C-02042, C-02681, C-03119, C-03527, C-03550, C-04038, C-04540, C-04687, C-04690, C-04691, C-05317, C-05620, C-06112, C-06494, C-06962, C-07710, C-07860, C-07871, C-11574, C-12593, C-16109, C-16801, C-17128, C-18696, C-21806, C-22877, C-23162, C-23546, C-24970, C-27044, C-28738, C-29738, C-30958, C-32476, C-33711, C-35956, C-38741, C-39719, C-40409, C-42926, C-43979, C-44083, C-46784, C-48492, C-48674, C-49476, C-49752, C-50876, C-53987, C-55125, C-59049, C-59513, C-60278, C-60951, C-63848, C-68086, C-70686, C-71244, C-71245, C-72015, C-74234, C-76212, C-79003, C-80573, C-84213, C-84214, C-84499, D-09590, D-19966, D-32679, D-43317, D-58339, D-66083, G-01096, H-20708, K-08420
GAS TURBINE ENGINES B-65638, B-67700
GASIFICATION B-65638, B-67700, B-75204, F-44721
GASOLINES A-09785, A-32060, A-34018, A-59494, C-53523, C-61851, G-27379, G-44597, G-68583, H-39537, K-10168, K-41682, K-51057, L-24122, L-32173, L-32245, L-48719
GENETICS G-30385, G-30387, G-37240, G-43636, H-03729, H-05560, H-06413, H-06681, H-18267, H-18507, H-19863, H-26055, H-27805, H-30473, H-31124, H-45533, H-66983, H-72762, H-76451
GEORGIA D-26086, L-48788
GERMANY, FEDERAL REPUBLIC A-00896, A-01528, A-02653, A-02988, A-08816, A-09541, A-17344, A-17464, A-17471, A-29519, A-29786, A-30218, A-30296, A-31333, A-32519, A-33735, A-34096, A-36212, A-37190, A-37562, A-37752, A-38657, A-39635, A-40401, A-40471, A-42675, A-42677, A-42680, A-42682, A-42685, A-46925, A-47048, A-47410, A-47959, A-47962, A-47963, A-47965, A-47966, A-48849, A-49924, A-50013, A-50381, A-50938, A-50961, A-51100, A-51102, A-51137, A-52508, A-52741, A-53295, A-53751, A-54622, A-55922, A-56192, A-59775, A-60727, A-60728, A-60866, A-61007, A-61154, A-61183, A-61800, A-66977, A-69039, A-69309, A-69422, A-71477, A-71615, A-76638, A-76644, A-77367, A-80507, A-80994, A-81343, A-82192, B-04368, B-04794, B-10618, B-15322, B-17463, B-18699, B-21795, B-24683, B-25178, B-25638, B-28320, B-28709, B-30276, B-33620, B-37402, B-37509, B-37603, B-38445, B-38476, B-38587, B-38593, B-40381, B-40712, B-40892, B-42078, B-42104, B-42172, B-42287, B-43108, B-44716, B-45254, B-45468, B-47463, B-47466, B-48143, B-48805, B-48811, B-48814, B-49979, B-50154, B-50937, B-51101, B-51755, B-51845, B-53620, B-54310, B-55524, B-55678, B-56078, B-56528, B-56591, B-59845, B-60849, B-60864, B-61259, B-63540, B-63775, B-64428, B-64506, B-64696, B-65638, B-66592, B-66947, B-67700, B-68795, B-69528, B-70537, B-74480, B-74483, B-77816, B-78814, B-78890, B-79657,

B-79711, B-80500, B-81256, B-81995, C-02681, C-05620, C-06962, C-11574, C-11915, C-17082, C-17098, C-18283, C-21156, C-22877, C-23575, C-24970, C-25474, C-26729, C-27130, C-29426, C-29737, C-29738, C-30014, C-30300, C-33929, C-36800, C-37350, C-38278, C-38280, C-38741, C-39008, C-39762, C-41020, C-41063, C-42375, C-46443, C-49391, C-52992, C-55367, C-55858, C-55923, C-56865, C-57079, C-58278, C-60010, C-61103, C-61859, C-61993, C-61995, C-63848, C-64090, C-65846, C-66606, C-67528, C-68944, C-72017, C-76212, C-77427, C-78426, C-82273, D-10619, D-19966, D-22348, D-22359, D-23862, D-25093, D-25593, D-29040, D-31396, D-34008, D-37607, D-43170, D-44799, D-50690, D-60574, D-63186, D-78442, E-44277, E-59075, E-59234, F-14907, F-16218, F-22219, F-55415, G-10842, G-11467, G-18809, G-26274, G-28556, G-30145, G-31319, G-32256, G-40597, G-47807, G-48030, G-48068, G-50161, G-54302, G-54968, G-55517, G-57024, G-57299, G-60625, G-60748, G-67440, G-71617, G-80078, G-84260, H-04816, H-10841, H-10843, H-11452, H-11466, H-11650, H-16150, H-16152, H-16222, H-17822, H-18226, H-18265, H-18266, H-18267, H-18270, H-18272, H-18319, H-18507, H-19539, H-19703, H-19873, H-20476, H-20917, H-21422, H-22624, H-23214, H-23639, H-23661, H-23874, H-23986, H-24024, H-24064, H-24330, H-24533, H-25099, H-25366, H-25750, H-27021, H-28477, H-28479, H-28483, H-28802, H-29277, H-29736, H-30142, H-30225, H-30297, H-30298, H-30301, H-31208, H-31733, H-32344, H-32516, H-32854, H-35877, H-35992, H-36742, H-36785, H-36994, H-36998, H-37346, H-37567, H-38017, H-38332, H-39190, H-39328, H-39537, H-39782, H-39887, H-39902, H-39932, H-40916, H-41362, H-41439, H-41696, H-41698, H-42954, H-43492, H-43493, H-45007, H-45022, H-45160, H-45467, H-45474, H-45781, H-46721, H-46733, H-47286, H-47806, H-48022, H-48798, H-49316, H-49647, H-50677, H-50729, H-52574, H-52964, H-53376, H-54297, H-55654, H-56584, H-56885, H-57475, H-59947, H-60957, H-60961, H-61496, H-63442, H-64166, H-64427, H-64860, H-66035, H-66983, H-67480, H-68122, H-68575, H-69596, H-72132, H-73172, H-76297, H-84290, I-47291, I-52320, I-56143, I-63871, I-73616, J-29923, J-38409, J-41121, K-11414, K-27010, K-60180, K-68582, K-78880, L-06754, L-17472, L-19434, L-25542, L-31492, L-32354, L-40461, L-40889, L-42873, L-42874, L-44054, L-46561, L-46586, L-48719, L-67888, L-77817, N-21287, N-32254, N-46820, N-51942, N-63776, N-65407, N-69692

GLADIOLUS A-12095, B-02541, B-28889, C-00626, C-00941, C-04757, C-26909, D-09590, D-37473, E-37037, E-76047, G-81181, H-00631, H-00964, H-00979, H-01506, H-01705, H-01800, H-02537, H-04678, H-04679, H-05324, H-08884, H-10673, H-11466, H-12042, H-14121, H-16222, H-17163, H-17449, H-17710, H-17822, H-18704, H-22887, H-24036, H-24566, H-25273, H-25499, H-26800, H-28480, H-30806, H-32280, H-32343, H-32714, H-36787, H-37403, H-48291, H-48556, H-52574, H-56240, H-60560, H-70745, H-70752, H-74721, H-79309, H-80067, H-80083, H-80085, H-82146, H-83723, H-84553, H-84651, K-26738

GLANDS G-04849, G-04983, G-06675, G-07344, G-29415, G-40920, G-47906, G-49271, G-66668, H-04850, H-11452, H-12551, H-12556, H-18271, H-39627

GLASS A-42677, A-43272, A-47965, A-51137, A-60729, A-66977, B-43481, B-45078, B-45757, B-46050, B-53603, B-53867, B-61935, B-63540, B-65640, B-66618, B-66624, C-60951, H-42601, H-48377, I-46606

GLASS FABRICS A-00896, A-06371, A-08816, A-11877, A-12470, A-26254, A-30296, A-31134, A-31144, A-33853, B-08344, B-18144, B-19177, B-19210, B-24110, B-45544, B-45707, C-03527, C-04038, C-04540, C-07871, C-12334, C-12593, C-18264, C-22517, C-22812, C-25487, C-26209, C-30300, C-34125, C-39022, C-48916, D-09590, D-25093, D-52578, E-33579, H-02200, H-11456, H-35880, H-38017, H-38412, H-39537, I-07553, J-39910, L-38573

GLASS MANUFACTURING AND PROCESSING A-79280, A-81745, C-82650, C-84463, H-80079

GLUE MANUFACTURING A-34018

GOATS G-03394, G-35569, G-50161, G-56931, G-56934, G-56959, G-64484, G-74822, G-74823, G-81018, H-00600, H-11469, H-12529, H-13203, H-32291, H-35877, H-43226, H-79633

GRAIN PROCESSING A-40159, A-43270, D-49860, J-30696

GRAPES A-13701, C-28441, C-28462, H-01800, H-01809, H-11456, H-17892, H-19147, H-24358, H-28446, H-28476, H-30142, H-30225, H-32539, H-54066, H-77050, H-80575

GRAPHITE G-52638

GRASSES A-00375, A-34018, A-48048, B-04368, B-09664, B-25433, C-00260, C-00264, C-00941, C-18264, C-27430, C-60410, C-72017, D-28188, D-30058, D-33309, D-44799, E-70747, G-01794, G-11467, G-74822, H-00187, H-00265, H-00266, H-00633, H-00944, H-00964, H-01800, H-02516, H-16222, H-17449, H-17822, H-18269, H-21422, H-22496, H-25230, H-26978, H-29277, H-29443, H-30297, H-30298, H-30301, H-32588, H-32736, H-32771, H-33290, H-39986, H-44295, H-45663, H-45781, H-48193, H-59947, H-60760, H-61496, H-67480, H-68394, H-75027, H-79129, H-81288, H-84290, L-19064

GRAVIMETRIC METHODS C-82650, H-81671

GRAVITY COLLECTORS A-15452, A-60827, B-29403, B-35106, B-38115, B-40251, B-40381, B-43299, B-45078, B-49023, B-52838, B-53868, B-70428, B-70840

GRAVITY SETTLING (CONTROL) B-29403, B-47677

GREAT BRITAIN A-00375, A-00896, A-06371, A-17377, A-27314, A-27930, A-31134, A-31283, A-32060, A-34334, A-44605, A-47061, A-51282, A-58939, B-07664, B-24033, B-26908, B-30519, B-35513, B-36716, B-37536, B-49023, B-52179, B-67217, B-67846, B-70428, C-16801, C-17092, C-17117, C-21730, C-24222, C-26203, C-30007, C-34125, C-34126, C-49879, C-82552, D-06809, D-52811, D-58218, E-64013, F-19175, F-39861, F-57581, F-78035, G-15040, G-18987, G-39494, G-43896, G-79848, H-11157, H-13213, H-16244, H-19604, H-24366, H-39493, H-40472, H-56428, H-70607, H-78402, H-79129, H-80189, L-17614, L-39306, L-39749, L-44054, L-44598, L-46586, N-04212, N-37027, N-64545

GREENHOUSES B-04853, C-01349, C-20701, C-27330, C-28251, D-09590, F-04768, G-01674, H-00187, H-00265, H-00301, H-00979, H-01705, H-05324, H-06413, H-07255, H-16222, H-18770, H-20917, H-26711, H-28802, H-30298, H-30299, H-44345, H-77325

GROUND LEVEL A-13615, A-35985, C-06279, C-25816, D-09590, D-14066, D-28188, E-29315, E-59234, E-64013, E-76047, E-78793, E-79132, H-32339, H-32516, H-36996, H-66983, K-51212, N-63776

GUINEA PIGS A-00375, C-07719, G-03394, G-06288, G-08031, G-18809, G-30145, G-39799, G-39810, G-39813, G-39924, G-39931, G-40635, G-44594, H-12551, H-12553, H-39627, H-40599

GYPSUM B-81040

H

HALOGEN GASES A-00640, A-01125, A-01528, A-03129, A-05090, A-05871, A-08882, A-09785, A-11453, A-13242, A-13615, A-17344, A-19400, A-22875, A-27617, A-30517, A-31315, A-31333, A-32060, A-34018, A-34096, A-36045, A-36377, A-37190, A-37721, A-38657, A-39460, A-39635, A-40344, A-40471, A-44681, A-45858, A-46925, A-47061, A-47188, A-47959, A-47963, A-47966, A-48946, A-49852, A-51282, A-55601, A-58402, A-59257, A-60421, A-60727, A-60728, A-60729, A-60866, A-61183, A-64926, A-67940, A-71262, A-73078, A-74512, A-75077, A-76274, A-76459, A-76638, A-79280, A-79567, A-79774, A-80238, A-80507, A-80994, A-81343, A-81745, A-83637, A-84479, B-02541, B-02962, B-04368, B-04794, B-07190, B-07664, B-07815, B-08344, B-12288, B-12465, B-14444, B-17463, B-18536, B-18641, B-18698, B-18699, B-21795, B-24033, B-25433, B-25638, B-25658, B-26908, B-29403, B-29725, B-30519, B-31567, B-32231, B-32232, B-32384, B-32627, B-35106, B-35111, B-36552, B-36716, B-37293, B-37402, B-37509, B-37809, B-37914, B-38445, B-38476, B-38504, B-38775, B-40381, B-41378, B-41839, B-42287, B-47054, B-47095, B-47256, B-47341, B-47680, B-48480, B-48811, B-48814, B-50652, B-50868, B-52094, B-52179, B-52852, B-53620, B-54310, B-55678, B-56064, B-58466, B-58632, B-60075, B-60255, B-61741, B-61935, B-62165, B-63784, B-64428, B-65638, B-68201, B-68633, B-70658, B-72038, B-72139, B-76512, B-77475, B-77838, B-80863, B-80950, B-81040,

B-81256, B-81772, B-81773, B-81944, B-83134, B-83613, B-84391, B-84418, C-00126, C-00626, C-00941, C-01793, C-02565, C-03119, C-03503, C-03908, C-04105, C-04405, C-04686, C-04757, C-05078, C-05439, C-05586, C-05620, C-06279, C-06338, C-06352, C-06398, C-06494, C-07719, C-07860, C-09770, C-09983, C-11626, C-13056, C-17082, C-17117, C-17128, C-18264, C-18696, C-19500, C-21881, C-22458, C-22812, C-22877, C-24118, C-24970, C-27962, C-28126, C-29426, C-29737, C-29738, C-29966, C-30793, C-30840, C-31115, C-31827, C-32966, C-35737, C-37350, C-38280, C-38670, C-38741, C-38917, C-39239, C-39243, C-39719, C-41719, C-41763, C-42928, C-44238, C-44253, C-44285, C-44933, C-45344, C-45760, C-46034, C-46303, C-47096, C-48315, C-48392, C-48492, C-49391, C-49509, C-49992, C-50093, C-50470, C-50876, C-50936, C-51762, C-52101, C-52206, C-55789, C-56681, C-59513, C-59814, C-60010, C-60419, C-61103, C-61851, C-61993, C-66606, C-69174, C-70686, C-72017, C-74221, C-74346, C-77492, C-79003, C-79032, C-80227, C-80259, C-82552, C-83442, C-84660, D-10619, D-17102, D-18537, D-19966, D-21419, D-22348, D-23862, D-25093, D-25593, D-31371, D-31396, D-32666, D-33108, D-34008, D-40896, D-70500, D-76890, E-02325, E-05054, E-30126, E-33092, E-37013, E-40271, E-43424, E-44277, E-79132, F-03062, F-13565, F-14907, F-21632, F-28428, F-44721, F-59528, F-78035, F-80516, F-81069, G-03246, G-07917, G-08031, G-10203, G-11444, G-12282, G-15040, G-18987, G-18988, G-19880, G-21455, G-31234, G-32601, G-33766, G-34398, G-36723, G-36947, G-37139, G-37684, G-38106, G-38616, G-38942, G-39833, G-40527, G-40635, G-43323, G-44589, G-45055, G-47807, G-48068, G-49448, G-49607, G-50161, G-56931, G-56934, G-56959, G-70519, G-71536, G-71933, G-72083, G-73658, G-74290, G-74821, G-74822, G-74823, G-79848, G-80197, G-81018, G-81250, G-83177, G-83179, G-84137, G-84260, G-84531, H-00301, H-00631, H-00633, H-01092, H-01506, H-01557, H-01800, H-03116, H-03395, H-03873, H-04816, H-04848, H-04984, H-05421, H-06354, H-08513, H-08884, H-09553, H-12042, H-12045, H-12554, H-13159, H-13474, H-16152, H-16385, H-17697, H-17710, H-18265, H-18266, H-18267, H-18268, H-18272, H-18319, H-19147, H-19539, H-19703, H-19873, H-20476, H-20573, H-20690, H-21062, H-21189, H-22084, H-22085, H-22092, H-22624, H-22930, H-23188, H-23661, H-24035, H-25099, H-27785, H-28474, H-28475, H-28477, H-28830, H-29206, H-29277, H-29991, H-30225, H-30368, H-30473, H-31527, H-32286, H-32339, H-32343, H-32344, H-32535, H-32536, H-32539, H-32588, H-32673, H-32714, H-32897, H-32982, H-34880, H-35613, H-35880, H-35964, H-35992, H-36159, H-36742, H-36996, H-38754, H-39183, H-39328, H-39493, H-39902, H-40202, H-40472, H-41362, H-41482, H-41699, H-41983, H-42086, H-43492, H-44411, H-44428, H-45022, H-45160, H-45467, H-45474, H-45776, H-46923, H-47014, H-48403, H-48639, H-48941, H-49316, H-49434, H-49644, H-49778, H-49779, H-50677, H-50780, H-51953, H-52102, H-52397, H-53376, H-56428, H-56885, H-57716, H-58381, H-58941, H-59184, H-60595, H-61000, H-62548, H-64427, H-65394, H-66983, H-67026, H-67056, H-67304, H-67348, H-67453, H-67457, H-68770, H-69488, H-70279, H-70357, H-70776, H-71931, H-74459, H-74626, H-76451, H-76838, H-78580, H-79973, H-79974, H-79976, H-80083, H-80085, H-83851, H-83856, H-84048, H-84477, H-84484, H-84557, H-84579, I-00085, I-00695, I-08076, I-23108, I-40510, I-58585, J-29923, J-38409, J-39910, K-03032, K-10168, K-14772, K-17375, K-27010, K-28466, K-31968, K-33107, K-34063, K-41267, K-42039, K-44377, K-51057, K-67267, K-68582, K-72151, K-74109, K-80854, L-06349, L-06734, L-06754, L-19434, L-25427, L-25542, L-25642, L-29598, L-29818, L-30620, L-31492, L-32884, L-35795, L-37747, L-38573, L-38669, L-39306, L-40889, L-41455, L-42021, L-42188, L-42873, L-42874, L-44054, L-46586, L-60630, L-76965, L-82278, L-83965, N-50748

HALOGENATED HYDROCARBONS A-08486, A-09785, A-23022, A-27930, A-30296, A-32060, A-34334, A-37562, A-39460, A-42680, A-47048, A-48572, A-49738, A-50938, A-50961, A-60727, A-71262, B-24683, B-32190, B-35111, B-41839, B-45707, B-49929, B-59230, B-61259, B-61954, B-68201, C-00264, C-08077, C-10632, C-17092, C-20030, C-20701, C-23654, C-25441, C-27769, C-31712, C-36125, C-39136, C-39871, C-40422, C-44933, C-65118, C-66753, C-79842, C-79843, C-83592, D-17102, E-29023, E-44030, E-77970, F-01677, F-02517, F-03062, F-53153, F-68048, F-69599, F-80516, G-01426, G-08702, G-12403, G-24720, G-30145, G-30841, G-45683, G-50916, G-52029, G-57701, G-68583, G-71536, G-71948, G-72961, G-79848, G-80197, G-84137, G-84260, H-20158, H-42857, H-42907, H-56213, H-59198, I-69995, K-10168, K-41682, K-44310, K-51057, K-60180, L-17188, N-66750

HAMSTERS G-07013

HAWAII A-79567

HAZE A-00220, A-80507, C-48392, D-39737, H-46198, L-39306, N-51942

HEADACHE G-11942, G-16874, G-84233, K-31968

HEALTH IMPAIRMENT A-00640, A-06241, A-11453, A-13699, A-15452, A-22875, A-28038, A-44566, A-60281, A-60421, A-71477, B-18144, B-26911, B-60282, C-24603, D-09590, D-26702, D-35764, D-39737, D-42760, D-47976, G-05833, G-06497, G-07344, G-08702, G-10203, G-11467, G-11942, G-24153, G-27379, G-30145, G-30788, G-31319, G-32607, G-33509, G-33510, G-35569, G-36751, G-36947, G-39924, G-39931, G-40527, G-47807, G-49164, G-50414, G-52147, G-56933, G-60228, G-60625, G-60748, G-61146, G-67325, G-68551, G-71484, G-71536, G-71617, G-72083, G-72961, G-73658, G-74580, G-74821, G-81250, G-83798, G-84233, H-00944, H-03116, H-06353, H-11452, H-11466, H-23624, H-25665, H-26718, H-32588, H-32982, H-33906, H-35877, H-40916, H-58381, H-60760, H-61496, H-64427, H-66715, H-83182, K-03582, K-08420, K-31968, K-60887, K-68224, K-71991, L-24010, L-28014, L-45783, N-66750

HEALTH STATISTICS D-47976, G-07344, G-11942, G-14112, G-18988, G-48697, G-62596, G-66044, G-71536, G-74369, H-01092, H-26734

HEARINGS C-44710, F-44721, L-06734, L-06938, L-32173, L-32245, L-32272

HEART C-20701, G-03246, G-04849, G-04983, G-06288, G-08030, G-25946, G-28754, G-36723, G-40597, G-48637, G-49164, G-52029, G-79619, H-04923, H-42907

HEAT CAPACITY B-5?046, F-01677, F-21632, I-00085

HEAT OF COMBUSTION A-48572, B-37536, C-10632

HEAT TRANSFER A-23022, A-23561, A-37562, A-40180, A-70069, B-18826, B-25038, B-25523, B-29114, B-32461, B-37536, B-37745, B-37809, B-38115, B-38504, B-44716, B-47125, B-47256, B-65638, B-70840, B-71796, C-01313, C-29771, C-31827, C-35956, F-01677, F-21632, F-44721, F-62189, H-00301, H-26711

HEAVY-DUTY VEHICLES A-12557, A-34018, A-48849, B-07549, I-23108, J-30696, K-72151

HEIGHT FINDING A-40344, B-50154, H-41370, K-37472, L-67888, N-63776, N-69692

HEMATOLOGY A-06241, A-11916, G-01426, G-04927, G-04983, G-06288, G-08031, G-10203, G-11942, G-12403, G-13215, G-14112, G-19880, G-24392, G-24720, G-29415, G-31319, G-32607, G-33505, G-33511, G-33766, G-36411, G-36723, G-37569, G-38106, G-40920, G-44362, G-48068, G-49164, G-49756, G-50371, G-54302, G-56931, G-56934, G-56959, G-57024, G-60625, G-62596, G-66668, G-58520, G-71948, G-74822, G-74823, G-78873, G-80857, H-04850, H-04923, H-05004, H-10843, H-12540, H-12554, H-12556, H-32588, H-48167, H-49434, H-65103, H-66715, K-08420, K-36823, N-20495

HEMOGLOBIN G-06288, G-12403, G-14112, G-29415, G-32607, G-33511, G-33766, G-36411, G-49756, G-74822, H-32588, H-66715

HERBICIDES C-69152, H-01800, H-03395, H-03616, H-03860, H-22789, H-40202, H-49779

HERBS E-64013, H-03873, H-24330, H-31208, H-36994, H-39493, H-79972, H-80067

HEXANES K-51057, K-74109

HEXENES H-03629

HI-VOL SAMPLERS A-02312, C-03527, C-03550, C-12451, C-22517, C-22812, C-24603, C-35108, C-39022, C-48916, C-51762, D-19966, D-26026, D-33858, D-43317, D-52811, G-19215, K-08420, L-24481, N-04212

HIGHWAYS A-76274, C-39762, D-31371, D-33425, G-47807, H-26055, H-26092, H-40368, H-56637

HISTAMINES C-67116

HISTOLOGY G-80857, H-79633

HISTORICAL ASPECTS K-79255
HOGS G-03394, G-44594, H-00600, H-11466, H-13159, H-13203, H-18271, H-28679, H-43226
HORMONES B-02541, G-08702, H-00600, H-03860, H-08884, H-31733
HOT SOAK L-09677
HOUSTON L-17614
HUMIDITY A-31581, A-80507, B-38775, B-42083, B-48480, B-61741, C-06338, C-07710, C-09770, C-10632, C-29771, C-29887, C-35956, C-48392, C-68944, D-23862, D-40896, E-04987, E-05054, E-30126, G-01674, G-26274, G-49756, G-68583, H-00301, H-08884, H-11157, H-19539, H-23295, H-23386, H-24064, H-25273, H-26055, H-26711, H-28446, H-28474, H-28476, H-28899, H-30301, H-31733, H-32535, H-32536, H-33716, H-38568, H-39466, H-40341, H-41189, H-41696, H-42923, H-42958, H-45007, H-45160, H-46923, H-47014, H-53376, H-55654, H-56240, H-60961, H-64427, I-00695, I-07553, I-27060, I-40833, I-46606, I-47291, I-54961, L-40889
HUNGARY B-83134, L-76397, L-83965
HYDRAZINES C-04458, C-06279, C-06494, C-06983, C-08077, C-09770, C-69152, C-80259, E-33092, G-06288, G-27895, G-71948, G-72961
HYDRIDES A-18449, H-00301
HYDROCHLORIC ACID A-08816, A-09799, A-11590, A-11876, A-12773, A-12889, A-17464, A-18449, A-26254, A-29532, A-29786, A-30218, A-30517, A-31315, A-31529, A-32855, A-36377, A-37562, A-37721, A-39460, A-40344, A-42676, A-42680, A-47048, A-47963, A-48116, A-48231, A-48572, A-49738, A-50242, A-50381, A-50938, A-50961, A-51102, A-52508, A-54622, A-55601, A-60421, A-60727, A-60728, A-61570, A-71615, A-74262, A-77522, A-80238, A-81745, A-82192, B-02541, B-06587, B-07549, B-07552, B-08344, B-22943, B-24033, B-26745, B-27282, B-33554, B-35106, B-36532, B-37536, B-38439, B-38504, B-41378, B-42104, B-44638, B-44716, B-45707, B-47054, B-47256, B-47466, B-47680, B-48805, B-49023, B-49929, B-49979, B-50154, B-50435, B-50868, B-50937, B-51101, B-52852, B-56078, B-56531, B-59230, B-59845, B-60864, B-61259, B-62165, B-64070, B-64696, B-66592, B-68795, B-70537, B-71412, B-71841, B-72139, B-73031, B-74480, B-74483, B-76008, B-76512, B-77475, B-78814, B-78890, B-79657, B-79711, B-80500, B-81772, B-82446, B-83613, B-83667, C-04458, C-05078, C-06962, C-17128, C-20030, C-22877, C-23162, C-24970, C-26122, C-27769, C-28126, C-32631, C-32643, C-35108, C-35737, C-36125, C-38280, C-39136, C-39719, C-41489, C-41719, C-41763, C-43985, C-44238, C-45760, C-46034, C-47096, C-47218, C-48492, C-48674, C-49509, C-49992, C-50337, C-50470, C-50876, C-51762, C-52992, C-60419, C-61851, C-61993, C-61995, C-63848, C-64779, C-65846, C-66606, C-66753, C-68944, C-69152, C-69174, C-71044, C-73127, C-74221, C-74942, C-75058, C-79842, C-79843, C-80573, C-80935, D-31371, D-31396, D-50744, D-66083, D-79343, F-20932, F-55415, F-62189, F-68048, G-31319, G-34398, G-41036, G-48068, G-57299, G-72961, G-84260, H-06395, H-08884, H-17710, H-19949, H-25865, H-28474, H-28475, H-28477, H-30473, H-32343, H-32714, H-32854, H-32982, H-35964, H-36742, H-39190, H-39537, H-39782, H-41699, H-42954, H-45007, H-45022, H-45130, H-45345, H-45557, H-49778, H-50677, H-50780, H-51953, H-52102, H-52928, H-65394, H-67026, H-67056, H-67304, H-67348, H-67457, H-68575, H-70776, H-84290, I-23108, I-39031, I-40510, I-46606, I-47291, I-56143, I-58585, I-65935, J-38409, K-33107, K-34063, K-38197, K-42039, K-44377, K-51057, K-60887, K-68582, K-72151, K-78880, L-17188, L-17472, L-17614, L-24481, L-29504, L-29818, L-32354, L-35795, L-37747, L-38669, L-39749, L-40461, L-40889, L-42021, L-42874, L-44054, L-73839, L-82278, N-04212, N-50748, N-63463, N-64937, N-66750
HYDROCYANIC ACID A-22875, A-32855, A-36377, A-48116, A-48572, A-50938, B-38504, B-49023, B-52852, B-79711, C-17128, C-21881, C-26122, C-32476, C-35737, C-36125, C-39719, C-43985, C-43986, C-44253, C-46303, D-35764, G-26274, G-41036, G-48068, G-71948, G-80197, G-84260, H-52928, I-23108, L-17188, L-82278
HYDRODESULFURIZATION A-61154, B-35106, B-38299
HYDROFLUORIC ACID A-00375, A-01125, A-05090, A-05871, A-06371, A-07650, A-08486, A-08816, A-08882, A-09799, A-11916, A-17471, A-17883, A-18449, A-23561, A-24370, A-26254, A-26329, A-29532, A-29786, A-30218, A-30296, A-30517, A-31134, A-31144, A-31315, A-31581, A-31935, A-33735, A-36377, A-37562, A-37721, A-40344, A-43816, A-44490, A-44566, A-44605, A-45858, A-46119, A-46558, A-48048, A-48116, A-48231, A-48572, A-48849, A-49617, A-49738, A-49886, A-50242, A-50381, A-50938, A-51282, A-52277, A-52508, A-52664, A-53874, A-54622, A-55407, A-55601, A-58334, A-58370, A-59921, A-60281, A-60421, A-61564, A-61570, A-63661, A-66955, A-68807, A-69309, A-71615, A-72125, A-74262, A-79280, A-79511, A-81745, A-82192, B-04853, B-05567, B-07190, B-07549, B-07552, B-08344, B-09773, B-13676, B-15322, B-15372, B-16555, B-16962, B-18698, B-18699, B-19487, B-20436, B-21034, B-22598, B-22853, B-22913, B-22923, B-22943, B-23370, B-24033, B-24110, B-24116, B-24834, B-26244, B-26317, B-26401, B-26674, B-26745, B-27569, B-28788, B-30276, B-30519, B-30814, B-31567, B-31708, B-31889, B-32384, B-33554, B-36532, B-37164, B-37402, B-37509, B-37536, B-37544, B-38439, B-38593, B-38874, B-40251, B-40414, B-41932, B-42078, B-42083, B-42104, B-42458, B-43299, B-44343, B-44638, B-44716, B-44838, B-45078, B-45468, B-45707, B-47054, B-47095, B-47186, B-47256, B-47466, B-47731, B-47821, B-48480, B-48805, B-48879, B-49031, B-49420, B-49979, B-50154, B-50435, B-50868, B-50937, B-51101, B-51755, B-51845, B-52094, B-53603, B-53620, B-53867, B-53875, B-54310, B-55046, B-56078, B-56531, B-57706, B-59230, B-59679, B-59845, B-59861, B-60075, B-60206, B-61259, B-61273, B-61741, B-62165, B-62786, B-64070, B-64506, B-64696, B-64898, B-64977, B-66592, B-66618, B-67217, B-68633, B-68795, B-69191, B-70537, B-71412, B-71472, B-71623, B-71841, B-72656, B-73031, B-73175, B-74480, B-74483, B-75138, B-75204, B-76008, B-76512, B-77475, B-78814, B-78890, B-79657, B-79711, B-80356, B-80500, B-81772, B-81773, B-81995, B-82446, B-83198, B-83667, B-84391, C-04038, C-04105, C-04458, C-04540, C-04686, C-04690, C-04757, C-05078, C-06279, C-06397, C-06983, C-07710, C-07763, C-07860, C-07871, C-09560, C-10632, C-11574, C-11691, C-15355, C-16801, C-17128, C-18230, C-20540, C-21730, C-21806, C-21855, C-22812, C-23162, C-23573, C-23657, C-23907, C-23947, C-24118, C-24222, C-24315, C-24372, C-24399, C-24970, C-25180, C-25487, C-25647, C-26121, C-26952, C-27330, C-27769, C-28126, C-28285, C-28374, C-28530, C-28738, C-29198, C-29220, C-29737, C-29738, C-29887, C-29966, C-30432, C-30793, C-30958, C-31115, C-31712, C-32476, C-32631, C-32643, C-33632, C-35108, C-35737, C-36125, C-36800, C-37463, C-37515, C-38670, C-39719, C-39871, C-40409, C-40705, C-41489, C-41763, C-43981, C-43986, C-44083, C-44238, C-44253, C-44933, C-46303, C-46784, C-47096, C-47218, C-48392, C-48492, C-48674, C-49476, C-49509, C-49992, C-50337, C-51551, C-52206, C-52992, C-53876, C-53987, C-56244, C-58278, C-59814, C-60553, C-61851, C-61993, C-61995, C-64090, C-64779, C-65846, C-66606, C-68944, C-69152, C-69174, C-69668, C-69675, C-70686, C-71044, C-72015, C-73127, C-73349, C-73471, C-74346, C-74471, C-75058, C-76030, C-79003, C-79389, C-79835, C-79842, C-79843, C-80423, C-80935, C-81357, C-81439, C-82273, C-84214, C-84499, D-09590, D-17986, D-19145, D-23862, D-26086, D-28771, D-30705, D-33108, D-34008, D-35764, D-36806, D-37502, D-37823, D-39182, D-39737, D-41979, D-47976, D-47982, D-48850, D-49118, D-50550, D-50744, D-66083, D-69744, D-73835, D-74121, D-77485, D-78954, D-79343, E-04987, E-05054, E-29774, E-43855, E-76047, E-79132, F-04768, F-13998, F-18427, F-18863, F-20932, F-46162, F-52013, F-55415, F-62189, F-68048, F-69599, G-04983, G-10333, G-11444, G-11467, G-12282, G-24392, G-24580, G-25160, G-26461, G-28199, G-28754, G-29043, G-30385, G-30387, G-30841, G-31319, G-32152, G-32596, G-32601, G-32606, G-32607, G-33276, G-33509, G-33511, G-33561, G-35569, G-36411, G-36751, G-36947, G-37240, G-40597, G-41036, G-41224, G-41634, G-41685, G-41686, G-41688, G-44867, G-45683, G-48068, G-50318, G-52686, G-52764, G-57024, G-57299, G-59073, G-60748, G-61146, G-64484, G-66668, G-71617, G-74369, G-81181, G-83179, G-84260, H-03766, H-04678, H-04679, H-04683, H-04688, H-04728, H-04732, H-04984, H-05324, H-05421,

H-05485, H-05667, H-06395, H-06413, H-08513, H-09683, H-10673, H-11452, H-11456, H-11466, H-11650, H-12155, H-13247, H-13985, H-15213, H-15404, H-16152, H-16222, H-16244, H-16265, H-16385, H-16399, H-16567, H-17109, H-17163, H-17449, H-17710, H-18268, H-18704, H-18770, H-19211, H-19657, H-19863, H-19949, H-20158, H-21000, H-21189, H-21194, H-21422, H-22499, H-23214, H-23222, H-23295, H-23386, H-23661, H-23794, H-23874, H-23986, H-23988, H-24036, H-24064, H-24402, H-24533, H-25273, H-25750, H-25865, H-26055, H-26175, H-26491, H-26711, H-26717, H-26800, H-26916, H-27805, H-28437, H-28600, H-28647, H-29010, H-29206, H-29736, H-30142, H-30225, H-30297, H-30298, H-30299, H-30301, H-30368, H-30805, H-30806, H-31124, H-31448, H-31527, H-31733, H-32280, H-32282, H-32334, H-32343, H-32535, H-32536, H-32714, H-32771, H-32854, H-33089, H-33716, H-34121, H-35578, H-35613, H-35964, H-35992, H-36742, H-37346, H-38017, H-38343, H-38404, H-38407, H-38412, H-38417, H-38419, H-38754, H-39190, H-39363, H-39466, H-39537, H-39684, H-39782, H-39887, H-39902, H-39932, H-39986, H-40202, H-40472, H-40899, H-41362, H-41439, H-41696, H-41698, H-41904, H-42601, H-42907, H-42954, H-42958, H-43492, H-43622, H-44595, H-45007, H-45009, H-45130, H-45214, H-45345, H-45467, H-45474, H-45557, H-45776, H-45781, H-46051, H-46338, H-46557, H-46721, H-46733, H-47286, H-47385, H-47806, H-48022, H-48377, H-48403, H-48639, H-48798, H-49561, H-49644, H-50157, H-50163, H-50780, H-51109, H-51470, H-51905, H-51953, H-52409, H-52574, H-52698, H-52928, H-53376, H-53903, H-54597, H-54755, H-54910, H-56204, H-56240, H-56241, H-56521, H-56584, H-56625, H-56655, H-58381, H-60560, H-60760, H-61410, H-63442, H-64166, H-64427, H-64588, H-64758, H-65394, H-65558, H-66714, H-66983, H-67457, H-68575, H-70487, H-70745, H-70776, H-70984, H-71931, H-73172, H-73510, H-74588, H-75027, H-76233, H-76715, H-79129, H-79586, H-79633, H-79972, H-80067, H-80083, H-80575, H-81288, H-81495, H-83082, H-83145, H-83723, H-83797, H-83885, H-84089, H-84290, H-84545, H-84557, H-84651, I-23108, I-27060, I-39031, I-40510, I-46606, I-47291, I-55143, I-65935, J-38409, J-39910, J-55161, K-17375, K-19750, K-27010, K-33107, K-34063, K-37472, K-41266, K-41295, K-42039, K-44310, K-51229, K-58638, K-58899, K-60180, K-60887, K-78880, L-06734, L-17188, L-17614, L-24481, L-27677, L-28349, L-29421, L-29504, L-29818, L-32789, L-35795, L-37747, L-38669, L-40889, L-42021, L-42188, L-44054, L-46586, L-47380, L-50180, L-67888, L-73836, L-73839, L-76965, L-77234, L-77817, L-84415, N-04212, N-44066, N-46820, N-49170, N-50748, N-64937, N-65407

HYDROGEN A-00640, A-02312, A-22875, A-29532, A-58402, A-6366¹, B-09902, B-12465, B-20857, B-31708, B-37544, B-38775, B-60864, B-79711, B-80213, C-00264, C-00941, C-01313, C-01349, C-04405, C-11041, C-24315, C-24359, C-25223, C-28102, C-31115, C-31827, C-39719, C-47096, C-56865, C-60419, D-52578, E-05054, F-14970, F-59528, F-80516, G-00165, G-01794, G-36947, G-79848, H-00187, H-00265, H-00266, H-00301, H-00788, H-00920, H-01506, H-02200, H-03572, H-19539, H-19703, H-28888, H-38017, H-56515, K-41295, N-63463

HYDROGEN SULFIDE A-00220, A-08882, A-09785, A-17344, A-18449, A-23561, A-23865, A-26254, A-31315, A-32060, A-32702, A-32855, A-34018, A-36045, A-36377, A-38657, A-39460, A-39862, A-40344, A-40471, A-40600, A-42682, A-43270, A-44566, A-45145, A-46925, A-47143, A-47962, A-49852, A-49924, A-50938, A-60281, A-60866, A-66977, A-67806, A-80238, B-02541, B-07549, B-08344, B-15322, B-22943, B-24033, B-26908, B-29403, B-29680, B-30519, B-31889, B-32190, B-35106, B-36532, B-41378, B-42078, B-43299, B-44793, B-45707, B-45846, B-47054, B-47680, B-48480, B-49031, B-60864, B-61741, B-62165, B-63474, B-64898, B-68633, B-79711, C-02681, C-03527, C-05586, C-06112, C-09983, C-11574, C-15171, C-16109, C-17092, C-20595, C-20650, C-22517, C-22812, C-22877, C-24603, C-25223, C-26122, C-27044, C-28126, C-29771, C-30840, C-31115, C-32476, C-32534, C-32643, C-35108, C-35441, C-35737, C-35956, C-38280, C-38670, C-39719, C-39871, C-40422, C-41763, C-42926, C-42928, C-43981, C-43985, C-43986, C-44253, C-44933, C-45760, C-46034, C-46303, C-47218, C-48392, C-48492, C-50337, C-50922, C-51762, C-58278, C-59814, C-60553, C-61103, C-61993, C-65118, C-65846, C-66606, C-68944, C-69174, C-74471, C-74942, C-79842, C-80103, C-80573, C-83592, C-84471, C-84660, D-09658, D-18537, D-25593, D-26702, D-31371, D-31396, D-32679, D-33108, D-33425, D-34008, D-39737, D-41979, D-44799, D-49860, E-04987, E-29774, E-40271, F-52013, F-68048, G-00165, G-03394, G-07098, G-18988, G-19148, G-24153, G-28199, G-34398, G-36751, G-38616, G-43323, G-44867, G-46085, G-48068, G-68583, G-71536, G-79848, G-80857, H-00301, H-03395, H-04984, H-08884, H-12042, H-12155, H-13474, H-17710, H-20158, H-23188, H-23295, H-23516, H-28475, H-30473, H-32982, H-35613, H-36742, H-39537, H-40202, H-41362, H-41696, H-41699, H-41983, H-42923, H-45345, H-47014, H-49778, H-49779, H-51526, H-52928, H-67457, I-00695, I-07553, I-23108, I-27060, I-46606, I-58585, I-69995, K-03582, K-08420, K-10168, K-11414, K-19750, K-19818, K-27010, K-28466, K-37472, K-44310, K-47672, K-51057, K-51212, K-51229, K-68582, K-72151, L-06349, L-06734, L-06754, L-17188, L-17472, L-17614, L-29504, L-29818, L-33722, L-40461, L-40889, L-41455, L-44054, L-47380, L-48719, L-50180, L-73839, N-04212, N-46820, N-49170, N-64937, N-65407, N-66750

HYDROGENATION A-22875, B-38299

HYDROLYSIS A-05811, A-08486, A-11916, B-43972, C-04463, C-08077, C-28530, C-30007, C-37799, G-24720

HYDROSPHERE D-33017, D-62438, E-30126, E-43424

HYDROXIDES B-46086, B-56591, B-59861, B-60075, B-60255, B-61954, C-06338, C-08077, C-24970, C-44177, E-33579, F-62189

HYGROMETERS C-09770

HYGROSCOPICITY C-57079

HYPERSENSITIVITY G-07098, G-61467

I

ICE D-33017, F-18863

ILLINOIS A-00896, D-24736, D-33080, D-52578, H-13474, L-09677

IMMUNOLOGY G-43636, G-57024, G-61467, H-04544, H-68575

IMPINGEMENT A-31529, A-40471, A-43816, B-22913, B-22943, B-26745, B-29680, B-37914, C-00126, C-00626, C-00636, C-00941, C-01313, C-01593, C-02042, C-02681, C-03550, C-04038, C-05439, C-06962, C-07710, C-07871, C-11574, C-11779, C-22517, C-22812, C-22877, C-24603, C-25487, C-28285, C-29426, C-29771, C-30300, C-30432, C-34125, C-34126, C-35956, C-39022, C-42926, C-43986, C-44881, C-47218, C-48916, C-60951, C-61957, C-68086, C-71245, C-76212, C-82273, D-19966, D-28771, D-39182, G-06485, G-08031, H-00631, H-18319, H-30142, L-24481

IMPINGEMENT PLATE TOWERS C-66753

INCINERATORS (REFUSE) A-05601, A-08816, A-09785, A-11590, A-11876, A-12773, A-12889, A-23865, A-25305, A-29532, A-29786, A-30218, A-31529, A-34018, A-34334, A-36377, A-37562, A-40344, A-40401, A-42675, A-45858, A-47048, A-47143, A-47188, A-47963, A-48231, A-50013, A-50381, A-50938, A-50961, A-51100, A-51102, A-52508, A-52741, A-53295, A-54622, A-55601, A-60727, A-67940, A-71262, A-71615, A-74262, A-80994, A-81745, A-81917, A-82192, B-24683, B-29680, B-35111, B-36552, B-37536, B-38439, B-44716, B-47680, B-49929, B-49979, B-50934, B-50937, B-51101, B-56078, B-59845, B-61259, B-61954, B-64696, B-68795, B-70840, B-71796, B-73031, B-74480, B-74483, B-78814, B-78890, B-79657, B-79711, B-80500, B-80950, B-81256, B-82446, B-83667, C-22812, C-35956, C-40211, C-44238, C-52992, C-75339, C-80935, D-25593, D-37994, G-31319, G-32607, H-42923, I-65935, J-48171, K-37472, K-51212, K-51229, K-72151, K-78880, L-09677, L-32173, L-32245, L-32272, L-40461, L-48788

INCINERATORS (WASTE GASES) A-12476, A-40180, A-40344, A-41650, A-42751, A-43270, A-47962, A-47963, A-48231, A-48849, A-52912, A-64926, A-67940, B-07549, B-28502, B-29680, B-30519, B-35111, B-42172, B-44638, B-45846, B-51845, B-58879, B-69131, B-70840, B-76512, L-24122, L-77234

INDIA B-81772, B-81773

INDIANA L-09677

INDOOR A-63661, C-79003, E-44030, G-84233, H-56521

INDUSTRIAL AREAS A-13615, A-31315, A-40471, A-46558, A-47061, A-52277, A-58334, A-67940, A-68703, A-74512, B-38476, C-11915, C-18344, C-20701, C-24222, C-25487, C-26713, C-39762, C-40705, C-60410, D-07579, D-09590, D-10619, D-17102, D-19145, D-19966, D-26026, D-28771, D-31371, D-31396, D-33108, D-33576, D-34008, D-35764, D-37502, D-37607, D-37823, D-37994, D-39182, D-41979, D-43317, D-47976, D-47982, D-48791, D-48850, D-49260, D-50550, D-51929, D-53889, D-54881, D-56792, D-58339, D-58427, D-63526, D-66083, D-69144, D-69744, D-70500, D-77485, D-78954, E-37639, E-49433, E-64013, G-06675, G-10333, G-12282, G-12532, G-14477, G-18988, G-19215, G-19880, G-23763, G-26274, G-28199, G-28754, G-29043, G-29415, G-30183, G-30788, G-31234, G-32152, G-32596, G-33766, G-37282, G-37569, G-38106, G-38942, G-40920, G-44867, G-47905, G-47906, G-48030, G-48636, G-48697, G-49164, G-49271, G-50371, G-56931, G-56933, G-62177, G-62596, G-64484, G-66044, G-68520, G-74369, G-79634, G-79980, G-81181, H-03116, H-12533, H-12554, H-17163, H-17449, H-17697, H-18269, H-18507, H-18704, H-20573, H-20917, H-22930, H-23188, H-23295, H-24036, H-27091, H-28437, H-29597, H-30142, H-35880, H-36883, H-36994, H-36996, H-36998, H-37480, H-38574, H-39607, H-39627, H-39895, H-40472, H-40599, H-41362, H-41698, H-41699, H-41904, H-41983, H-42601, H-46217, H-46733, H-46997, H-47385, H-48167, H-48193, H-48377, H-48556, H-48941, H-50959, H-51109, H-51470, H-51484, H-51754, H-52574, H-55066, H-56584, H-56874, H-56885, H-57475, H-58506, H-58507, H-58777, H-58941, H-59327, H-60907, H-61000, H-64166, H-64758, H-65103, H-65179, H-65394, H-65715, H-66798, H-68394, H-69488, H-74459, H-74588, H-76233, H-77377, H-77421, H-81288, H-81771, H-82208, H-82498, H-83258, H-84650, I-00695, I-58585, J-32706, K-33107, L-06349, L-09677, L-17614, L-29598, L-31492, L-32354, L-38573, L-41455, L-44054, L-81399, L-82278, L-83965, M-68522

INDUSTRIAL INORGANIC CHEMICAL PLANTS A-76411, B-81772, B-81773

INDUSTRIAL-COMMERCIAL INCINERATORS A-80994

INERTIAL SEPARATION B-29114, B-29403, B-35106, B-49023, B-70840

INFECTIOUS DISEASES G-43636, G-61467, H-46733, K-78880

INFLUENZA G-08702, G-11942

INFRARED RADIATION C-44238, C-50337, C-66753, C-75058, K-19818

INFRARED SPECTROMETRY A-48116, C-02681, C-22877, C-24603, C-26729, C-29198, C-31115, C-35108, C-39022, C-41489, C-43979, C-43985, C-43986, C-46034, C-48315, C-48492, C-49752, C-49879, C-49992, C-50337, C-51762, C-58278, C-63848, C-69174, C-74942, C-75058, C-79843, C-83495, C-83592, E-04987, E-43855, F-02517, F-04468, F-04674, F-32952, F-81496, G-01096, H-02516, H-07255, H-12032, I-00085, K-08420, L-17472

INGESTION C-29220, D-13838, F-07714, F-26990, G-04983, G-14112, G-22551, G-23763, G-25946, G-26461, G-28019, G-28037, G-37569, G-37684, G-37795, G-38942, G-39799, G-39813, G-39931, G-44593, G-44594, G-47807, G-56931, G-61646, G-62177, G-64484, G-81018, G-84266, H-01092, H-04544, H-04917, H-04918, H-04919, H-04923, H-04924, H-04925, H-04997, H-05004, H-10711, H-17620, H-18268, H-18269, H-18270, H-24944, H-25735, H-26734, H-26742, H-28031, H-28035, H-28258, H-29206, H-29736, H-33906, H-35877, H-38407, H-38417, H-39607, H-40201, H-48167, H-64427, H-66035, H-68770, H-76297, H-80064

INHALATION G-79623, H-76297, H-80064

INHALATION THERAPY G-01426, G-10362, G-33276, G-33505, G-33872

INHIBITION D-26026, F-22219, G-01728, G-04927, G-24720, G-41685, G-41687, G-41688, G-43277, G-44594, G-54968, G-79796, H-03570, H-04728, H-06342, H-07046, H-08513, H-10843, H-14678, H-21498, H-21500, H-23794, H-26175, H-28437, H-39698, H-44345, H-45160, H-47806, H-52306, H-54597, H-56204, H-56963, H-62548, H-71931

INORGANIC ACIDS A-00340, A-00375, A-01125, A-03129, A-03450, A-04068, A-05090, A-05871, A-06371, A-07650, A-08116, A-08486, A-08816, A-08882, A-09214, A-09321, A-09332, A-09785, A-09799, A-11590, A-11876, A-11916, A-12749, A-12773, A-12809, A-12813, A-12889, A-12933, A-13242, A-17076, A-17464, A-17471, A-17883, A-18323, A-18449, A-21380, A-23561, A-23865, A-24370, A-26254, A-26329, A-29532, A-29786, A-30218, A-30296, A-30517, A-31134, A-31144, A-31315, A-31529, A-31581, A-31935, A-32060, A-32702, A-32855, A-33735, A-36377, A-37562, A-37721, A-39460, A-39862, A-40344, A-42676, A-42680, A-43816, A-44490, A-44566, A-44605, A-45858, A-46119, A-46558, A-47048, A-47963, A-48048, A-48116, A-48231, A-48572, A-48849, A-49617, A-49738, A-49852, A-49886, A-49924, A-50242, A-50381, A-50938, A-50961, A-51102, A-51282, A-52277, A-52508, A-52664, A-53874, A-54622, A-55212, A-55407, A-55601, A-58334, A-58370, A-59921, A-60281, A-60421, A-60727, A-60728, A-61564, A-61570, A-63661, A-66955, A-68807, A-69309, A-71262, A-71615, A-72125, A-74262, A-75089, A-77522, A-79280, A-79511, A-80238, A-81745, A-82192, B-02541, B-04853, B-05567, B-06587, B-07190, B-07549, B-07552, B-08344, B-09773, B-13676, B-15322, B-15372, B-16555, B-16962, B-17485, B-18698, B-18699, B-18826, B-19487, B-20436, B-21034, B-22598, B-22853, B-22913, B-22923, B-22943, B-23370, B-24033, B-24110, B-24116, B-24834, B-25038, B-25178, B-26244, B-26317, B-26401, B-26674, B-26745, B-27282, B-27569, B-27835, B-28783, B-30276, B-30519, B-30814, B-31567, B-31708, B-31889, B-32231, B-32384, B-32461, B-33554, B-33620, B-33918, B-35106, B-35111, B-36532, B-36716, B-37080, B-37164, B-37402, B-37509, B-37536, B-37544, B-37914, B-38439, B-38504, B-38593, B-38874, B-40251, B-40414, B-41378, B-41932, B-42078, B-42083, B-42104, B-42458, B-43299, B-43972, B-44343, B-44638, B-44716, B-44793, B-44838, B-45078, B-45254, B-45468, B-45707, B-45846, B-46086, B-47054, B-47095, B-47186, B-47256, B-47466, B-47680, B-47731, B-47821, B-48143, B-48480, B-48805, B-48879, B-49023, B-49031, B-49420, B-49929, B-49979, B-50154, B-50435, B-50868, B-50937, B-51101, B-51755, B-51845, B-52094, B-52852, B-53603, B-53620, B-53867, B-53875, B-54310, B-54799, B-55046, B-56078, B-56531, B-57706, B-58466, B-58632, B-59230, B-59679, B-59845, B-59861, B-60075, B-60206, B-60864, B-61259, B-61273, B-61741, B-62165, B-62786, B-63540, B-64070, B-64506, B-64696, B-64898, B-64977, B-66592, B-66618, B-67136, B-67137, B-67217, B-67846, B-68633, B-68795, B-69131, B-69191, B-69965, B-70537, B-71412, B-71472, B-71623, B-71841, B-72139, B-72656, B-73031, B-73175, B-74480, B-74483, B-75138, B-75204, B-76008, B-76512, B-77475, B-78814, B-78890, B-79657, B-79711, B-80356, B-80500, B-81772, B-81773, B-81995, B-82446, B-83198, B-83613, B-83667, B-84391, C-00626, C-00941, C-01593, C-03119, C-04038, C-04105, C-04458, C-04540, C-04686, C-04690, C-04757, C-05078, C-06279, C-06397, C-06962, C-06983, C-07710, C-07763, C-07860, C-07871, C-09560, C-09983, C-10632, C-11574, C-11691, C-15355, C-16801, C-17128, C-18230, C-18264, C-20030, C-20540, C-20595, C-21730, C-21806, C-21855, C-22812, C-22877, C-23162, C-23573, C-23657, C-23907, C-23947, C-24114, C-24118, C-24222, C-24315, C-24372, C-24399, C-24970, C-25180, C-25487, C-25647, C-26121, C-26122, C-26952, C-27330, C-27769, C-28126, C-28285, C-28374, C-28530, C-28738, C-29198, C-29220, C-29737, C-29738, C-29887, C-29966, C-30432, C-30793, C-30840, C-30958, C-31115, C-31712, C-32476, C-32631, C-32643, C-33632, C-35108, C-35737, C-36125, C-36693, C-36800, C-37463, C-37515, C-38280, C-38670, C-39136, C-39719, C-39871, C-40409, C-40705, C-41489, C-41719, C-41763, C-42928, C-43981, C-43985, C-43986, C-44083, C-44177, C-44238, C-44253, C-44881, C-44933, C-45760, C-46034, C-46303, C-46784, C-47096, C-47218, C-48392, C-48492, C-48674, C-49476, C-49509, C-49992, C-50337, C-50470, C-50876, C-51551, C-51762, C-52206, C-52992, C-53876, C-53987, C-56244, C-58278, C-59814, C-60419, C-60553, C-61103, C-61851, C-61993, C-61995, C-63848, C-64090, C-64779, C-65846, C-66606, C-68944, C-69152, C-69174, C-69668, C-69675, C-70686, C-71044, C-72015, C-73127, C-73349, C-73471, C-74221, C-74346, C-74471, C-74942, C-75058, C-76030, C-79003, C-79389, C-79835, C-79842, C-79843, C-80103, C-80423, C-80573, C-80935, C-81357, C-81439, C-82273, C-84214, C-84499, D-09590, D-09658, D-17986, D-19145, D-23862, D-26086,

D-28771, D-30705, D-31371, D-31396, D-33108, D-34008, D-35764, D-36806, D-37502, D-37823, D-39182, D-39737, D-41979, D-43317, D-47976, D-47982, D-48850, D-49118, D-50550, D-50744, D-66083, D-69744, D-73835, D-74121, D-77485, D-78954, D-79343, E-04987, E-05054, E-29774, E-43855, E-76047, E-79132, F-04768, F-13998, F-18427, F-18863, F-20932, F-41543, F-46162, F-52013, F-55415, F-62189, F-68048, F-69599, G-03394, G-04983, G-06675, G-10333, G-11444, G-11467, G-12282, G-18988, G-24392, G-24580, G-25160, G-26461, G-26873, G-27379, G-28199, G-28754, G-29043, G-30385, G-30387, G-30841, G-31319, G-32152, G-32596, G-32601, G-32606, G-32607, G-33276, G-33509, G-33510, G-33511, G-33561, G-34398, G-35569, G-36411, G-36751, G-36947, G-37240, G-38721, G-40597, G-41036, G-41224, G-41684, G-41685, G-41686, G-41688, G-44867, G-45683, G-48068, G-50318, G-50916, G-52686, G-52764, G-57024, G-57299, G-59073, G-60748, G-61146, G-64484, G-66668, G-68583, G-71536, G-71617, G-72961, G-73658, G-74369, G-81181, G-83179, G-84260, H-03766, H-04678, H-04679, H-04683, H-04688, H-04728, H-04732, H-04984, H-05324, H-05421, H-05485, H-05667, H-06395, H-06413, H-08513, H-08884, H-09683, H-10673, H-11452, H-11456, H-11466, H-11650, H-12155, H-13247, H-13985, H-15213, H-15404, H-16152, H-16222, H-16244, H-16245, H-16385, H-16399, H-16567, H-17109, H-17163, H-17449, H-17710, H-18226, H-18268, H-18319, H-18704, H-18770, H-19211, H-19657, H-19863, H-19949, H-20158, H-21000, H-21189, H-21194, H-21422, H-22499, H-23214, H-23222, H-23295, H-23386, H-23661, H-23794, H-23874, H-23986, H-23988, H-24024, H-24036, H-24064, H-24402, H-24533, H-25273, H-25750, H-25865, H-26055, H-26175, H-26491, H-26711, H-26717, H-26800, H-26916, H-27805, H-28437, H-28474, H-28475, H-28477, H-28600, H-28647, H-29010, H-29206, H-29736, H-30142, H-30225, H-30297, H-30298, H-30299, H-30301, H-30368, H-30473, H-30805, H-30806, H-31124, H-31448, H-31527, H-31733, H-32280, H-32282, H-32334, H-32343, H-32535, H-32536, H-32714, H-32771, H-32854, H-32982, H-33089, H-33716, H-34121, H-35578, H-35613, H-35964, H-35992, H-36742, H-36998, H-37346, H-38017, H-38343, H-38404, H-38407, H-38412, H-38417, H-38419, H-38574, H-38754, H-39190, H-39363, H-39466, H-39537, H-39627, H-39684, H-39782, H-39887, H-39902, H-39932, H-39986, H-40202, H-40472, H-40899, H-41362, H-41439, H-41696, H-41698, H-41699, H-41904, H-42601, H-42907, H-42954, H-42958, H-43492, H-43622, H-44595, H-45007, H-45009, H-45022, H-45130, H-45214, H-45345, H-45467, H-45474, H-45557, H-45776, H-45781, H-46051, H-46338, H-46557, H-46721, H-46733, H-46997, H-47286, H-47395, H-47806, H-48022, H-48167, H-48302, H-48403, H-48639, H-48798, H-49561, H-49644, H-49778, H-50157, H-50163, H-50677, H-50780, H-51109, H-51470, H-51526, H-51905, H-51953, H-52102, H-52409, H-52574, H-52698, H-52705, H-52928, H-53376, H-53903, H-54597, H-54755, H-54910, H-56204, H-56240, H-56241, H-56521, H-56584, H-56625, H-56655, H-58381, H-60560, H-60760, H-61410, H-63442, H-64166, H-64427, H-64588, H-64758, H-65394, H-65558, H-66714, H-66983, H-67026, H-67056, H-67304, H-67348, H-67457, H-68575, H-68770, H-70487, H-70745, H-70776, H-70984, H-71931, H-73172, H-73510, H-74588, H-75027, H-76233, H-76451, H-76715, H-79129, H-79586, H-79633, H-79972, H-80067, H-80083, H-80575, H-81288, H-81495, H-83082, H-83145, H-83723, H-83797, H-83885, H-84089, H-84290, H-84545, H-84557, H-84651, I-07553, I-23108, I-27060, I-39031, I-40510, I-46606, I-47291, I-52320, I-56143, I-58585, I-65935, J-30696, J-38409, J-39910, J-55161, K-08420, K-10168, K-17375, K-19750, K-27010, K-28466, K-33107, K-34063, K-36823, K-37472, K-38197, K-41266, K-41295, K-41682, K-42039, K-44310, K-44377, K-47672, K-51057, K-51212, K-51229, K-58638, K-58899, K-60180, K-60887, K-66916, K-68582, K-72151, K-78880, L-06349, L-06734, L-17188, L-17472, L-17614, L-24481, L-27677, L-28349, L-29421, L-29504, L-29818, L-32354, L-32789, L-35795, L-37747, L-38669, L-39749, L-40461, L-40889, L-41455, L-42021, L-42188, L-42874, L-44054, L-46586, L-47380, L-48788, L-50180, L-67888, L-73836, L-73839, L-76965, L-77234, L-77817, L-82278, L-84415, N-04212, N-44066, N-46820, N-49170, N-50748, N-63463, N-64937, N-65407, N-66750

INSECTS H-77377, H-80079, H-83145, H-83182, H-83258, H-84080, H-84089, H-84477, H-84527, H-84541, H-84545

INSPECTION A-48429, A-60421, B-15372, L-39749, L-40461, L-59722, L-60630

INSPECTORS D-26702, L-39749, L-59722

INSTRUMENTATION C-00626, C-00636, C-01349, C-03503, C-04405, C-04685, C-04689, C-04691, C-06279, C-06338, C-06983, C-07871, C-14288, C-22879, C-24118, C-28671, C-32643, C-32966, C-35737, C-35956, C-36002, C-39871, C-40211, C-42926, C-43570, C-44253, C-44933, C-47193, C-47218, C-48392, C-49879, C-50337, C-50470, C-50876, C-50922, C-52629, C-55125, C-57079, C-59814, C-60419, C-61103, C-61993, C-61995, C-64090, C-65118, C-69152, C-69675, C-71231, C-71244, C-79245, C-74346, C-75058, D-29040, D-32679, D-50307, E-04987, F-04768, F-07714, F-52013, G-08030, H-03549, H-06459, H-46557, H-48374, J-42746, L-33495

INTERMITTENT MONITORING C-02681, C-11574, C-21855, C-22458, C-22879, C-26122, C-29426, C-36002, C-43979, D-22348, D-23845, D-37994, D-40896, H-32897, H-41370, L-33495

INTERNAL COMBUSTION ENGINES A-20134, A-29786, A-34018, A-48946, A-49924, B-07549, B-35111, C-26713, C-35108, D-25593, D-34008, L-09677, L-24122

INTERNATIONAL AGENCIES B-80213

INTESTINES G-04983, G-16874, G-32606

INVERSION A-07650, A-09785, A-31333, A-32702, A-44566, B-25195, D-09590, D-26086, D-33309, D-33858, D-39182, D-40896, D-48791, E-05054, E-14897, E-59234, G-18785, G-18988, G-30788, G-36751, G-40597, G-44867, G-49756, H-57810, H-78580, I-07553, L-82278, N-49170

INVERTEBRATES G-81250, H-77377, H-80079, H-83145, H-83182, H-83258, H-84080, H-84089, H-84477, H-84527, H-84541, H-84545

IODIDES A-29786, B-61954, C-07860, C-23096, C-25223, C-43234, E-78933, F-02517, G-16047, H-00301

IODIMETRIC METHODS A-31529, C-02681, C-17092, C-20595, C-22812, C-24603, C-26122, C-27248, C-29198, C-31115, C-32476, C-35956, C-39022, C-39719, C-43985, C-43986, C-48916, C-49992, C-60419, C-83495

IODINATED HYDROCARBONS F-02517, F-03062

IODINE A-76638, A-81343, C-11626, C-22458, C-24118, C-32966, C-80227, E-79132, F-28428, G-71933, H-41362, H-45022, L-25542, L-29818

IODINE COMPOUNDS A-29786, B-61954, C-07860, C-23096, C-25223, C-27294, C-43234, D-33017, D-52578, D-56464, E-29910, E-78933, F-02517, F-28428, G-16047, H-00301, H-52397, H-79976, K-51057

ION EXCHANGING B-78245

IONIZATION B-71841, C-27962, C-36125, C-47096, D-34008, F-21389, I-54961

IONIZATION CHAMBERS C-06279

IONS A-08882, A-53955, A-79511, B-71623, C-00260, C-00264, C-02042, C-04463, C-05439, C-08077, C-12334, C-17082, C-19076, C-23654, C-24279, C-25668, C-26259, C-30007, C-30793, C-31712, C-32450, C-32534, C-33711, C-36800, C-37579, C-44174, C-44177, C-44238, C-44552, C-45802, C-47096, C-47193, C-55125, C-64779, C-80495, C-82273, C-84209, D-77485, E-30126, F-07714, F-21389, F-34948, F-41543, G-04927, G-24720, G-28037, G-41685, G-50318, G-79796, G-79980, G-84236, H-02041, H-45160, H-83797, K-41266

IRELAND E-29023, L-80894

IRIS H-79635, H-83723

IRON A-11916, A-17471, A-26136, A-30296, A-31935, A-35592, A-38657, A-39460, A-40159, A-40180, A-40182, A-41650, A-41877, A-42682, A-42683, A-42751, A-45858, A-47962, A-49617, A-49924, A-52912, A-59775, A-60866, A-61564, A-64926, A-67806, A-69039, B-04794, B-05567, B-06587, B-07664, B-08344, B-10618, B-19210, B-23182, B-32627, B-33918, B-40892, B-43108, B-45078, B-47125, B-47677, B-50652, B-58380, B-58879, C-49391, C-53625, C-58842, C-60951, C-68086, D-09590, D-09658, D-39737, D-49260, D-49860, D-63526, G-01096, G-28556, G-48697, G-66044, H-08884, H-32282, H-38568, H-50959, H-65715, I-00085, I-07553, I-23108, I-39031, I-40510, I-40833, I-46606, I-54961, I-63871, J-29923, J-30696, J-39910, J-48171, L-29598, L-38573, L-39749, L-59722, N-21287

IRON AND STEEL FOUNDRIES A-82944, B-83198

IRON COMPOUNDS A-09785, A-11916, A-27314, A-42731, A-50938, A-51100, A-52741, A-54622, A-61564, A-75077, A-79567, A-80238, A-80994, A-81169, A-81931, B-32461, B-58879, B-75204, B-77838, C-23096, C-24114, C-24331, C-28126, C-39136, C-39516, C-42928, C-50936, C-55789, C-75339, C-80227, D-21419, D-31371, D-49260, D-50307, D-51929, D-76890, D-83399, E-29910, E-43424, G-04145, G-39833, G-52029, H-00979, H-08884, H-30368, H-35880, H-45160, H-50959, H-51754, H-65179, H-67348, H-71078, H-84390, I-47291, K-74109
IRON OXIDES A-17471, A-27930, A-41877, A-49617, A-71477, A-82279, B-07552, B-07664, B-24834, B-32627, B-43863, G-08201, G-16916, G-52638, H-16567, I-07553, K-58638
ISOBUTANES E-76047, F-25636
ISOTOPES A-17883, A-59921, B-12127, C-04405, C-07860, C-27294, C-32534, C-32966, E-33579, E-40271, E-77970, F-04674, G-10247, G-33561, G-41685, H-02382, H-04683, H-05399, H-10150, H-50503, H-50505
ITALY A-13701, A-23865, A-40600, A-55601, A-80334, B-46086, C-25223, C-30793, C-30958, C-32631, C-37579, C-41624, C-43570, C-45760, C-49992, C-83495, C-84471, D-18537, D-21419, D-23392, D-40896, G-11444, G-13215, G-14112, G-14319, G-32152, G-37282, G-40635, G-56538, G-79980, H-11456, H-24035, I-24308, J-30226, K-68582, L-25427, L-44598, L-46586

J

JAPAN A-00375, A-17405, A-26136, A-28652, A-29532, A-31144, A-31935, A-32855, A-36377, A-37721, A-40182, A-42054, A-43816, A-46558, A-47945, A-49617, A-52277, A-52664, A-53874, A-58334, A-58370, A-58402, A-60421, A-61564, A-61570, A-72125, A-74512, A-76274, A-77522, A-81745, A-82269, A-82353, A-82944, A-83543, A-84542, B-07549, B-14444, B-16555, B-19210, B-19212, B-28783, B-28786, B-30814, B-31889, B-33918, B-33971, B-35106, B-36475, B-37164, B-37809, B-38115, B-38504, B-42083, B-44343, B-47054, B-47125, B-47256, B-47341, B-47731, B-48480, B-48879, B-49420, B-50435, B-50868, B-52445, B-53867, B-53868, B-53875, B-56531, B-58380, B-59679, B-60075, B-60255, B-61741, B-61935, B-62165, B-64898, B-64977, B-65640, B-66624, B-68633, B-69191, B-70658, B-70659, B-71412, B-71472, B-72038, B-72139, B-73175, B-82032, B-83198, B-83613, C-03908, C-06112, C-12451, C-15171, C-19500, C-20650, C-21806, C-21855, C-26121, C-26122, C-26952, C-28102, C-28126, C-28530, C-28738, C-29220, C-29467, C-29966, C-31115, C-32476, C-32534, C-33711, C-35108, C-35737, C-36002, C-37463, C-37515, C-38670, C-38905, C-38917, C-39136, C-39516, C-40138, C-40409, C-41719, C-41763, C-44253, C-44552, C-47096, C-47218, C-48315, C-48492, C-48674, C-49509, C-49752, C-50093, C-50470, C-50876, C-50936, C-53625, C-53876, C-55789, C-58278, C-58842, C-59814, C-60419, C-61851, C-61896, C-64779, C-69174, C-70638, C-71044, C-73349, C-74221, C-74346, C-74471, C-74942, C-77492, C-80227, C-80935, C-84175, C-84182, C-84209, C-84213, C-84214, C-84660, D-26026, D-27254, D-28771, D-31371, D-33108, D-33576, D-35764, D-36806, D-37502, D-37994, D-39054, D-41979, D-43317, D-44267, D-47976, D-48791, D-48850, D-49118, D-49260, D-50550, D-50744, D-51929, D-53889, D-54881, D-58339, D-58427, D-61140, D-66083, D-67690, D-69744, D-70500, D-71348, D-71362, D-73835, D-74121, D-76890, D-77485, D-77512, D-78193, D-78954, D-79343, D-83399, D-84625, E-33579, E-49185, E-49433, G-03246, G-04145, G-04734, G-19215, G-23003, G-26846, G-28754, G-29043, G-29415, G-30183, G-38106, G-38942, G-40527, G-40920, G-43323, G-45683, G-47905, G-47906, G-48636, G-48637, G-49164, G-49271, G-49607, G-50318, G-50371, G-50414, G-50419, G-50916, G-52029, G-56931, G-56933, G-56934, G-56959, G-57701, G-60228, G-61146, G-61467, G-62177, G-64484, G-68520, G-71324, G-71484, G-74369, G-74380, G-74580, G-74821, G-74822, G-74823, G-76902, G-79619, G-79623, G-79634, G-79796, G-81018, G-81181, G-83177, G-83179, G-83798, G-84266, G-84531, H-10342, H-16385, H-16399, H-19911, H-20707, H-20708, H-21189, H-21194, H-23988, H-28149, H-28647, H-29443, H-29597, H-30368, H-30805, H-30806, H-31124, H-32714, H-33716, H-35964, H-38754, H-40899, H-41904, H-41983, H-42086, H-42601, H-48291, H-48377, H-48556, H-48639, H-48941, H-49434, H-49573, H-50157, H-50163, H-50415, H-50503, H-50505, H-51754, H-51953, H-52096, H-52102, H-52135, H-52409, H-52698, H-52928, H-53903, H-54066, H-54597, H-58777, H-58941, H-59327, H-61410, H-61834, H-64758, H-64824, H-65715, H-70279, H-70357, H-70745, H-70776, H-71078, H-71098, H-74459, H-74721, H-74722, H-76838, H-76901, H-77050, H-77325, H-77329, H-77390, H-77391, H-77421, H-78681, H-79309, H-79586, H-79633, H-79635, H-79972, H-79973, H-79974, H-79976, H-80064, H-80067, H-80079, H-80083, H-80085, H-81671, H-82146, H-82208, H-82435, H-82498, H-82520, H-83145, H-83182, H-83258, H-83721, H-83723, H-83730, H-83797, H-83849, H-83851, H-83854, H-83856, H-83885, H-84048, H-84080, H-84089, H-84527, H-84541, H-84545, H-84548, H-84551, H-84553, H-84557, H-84558, H-84579, H-84650, H-84651, I-23108, I-58585, K-19818, K-31968, K-33107, K-34063, K-36823, K-38197, K-42039, K-44310, K-44377, K-46081, K-47672, K-51057, K-58899, K-68582, K-72145, K-72151, K-74109, K-80854, L-17188, L-27677, L-28349, L-29421, L-29504, L-29598, L-29818, L-30620, L-32789, L-32884, L-33722, L-35795, L-37747, L-37943, L-38669, L-42021, L-42188, L-44054, L-50180, L-52026, L-64940, L-73836, L-73839, L-76847, L-76965, L-77234, L-81220, L-81399, L-82278, M-68522, N-04212, N-50748, N-50867, N-64937
JET AIRCRAFT G-72961

K

KANAGAWA PREFECTURE B-65640, C-39136, D-76890, H-48941, H-51754, H-70279, H-71078, H-77329
KENTUCKY D-56465, L-09677
KETONES A-00220, A-09785, A-23561, A-31315, A-31529, A-32855, A-42680, A-71262, A-79280, B-42078, B-60864, C-04405, C-04463, C-20650, C-42928, C-44933, C-45802, C-65118, C-80259, C-83592, F-02337, G-04927, G-26274, G-30841, G-84260, H-04544, K-41682, K-51057, L-32173, L-32245
KIDNEYS A-81169, C-07719, C-20701, G-03246, G-04849, G-04983, G-06288, G-07917, G-08030, G-08031, G-11000, G-11467, G-12987, G-21455, G-25946, G-28199, G-36751, G-49223, G-49448, G-54302, G-79619, G-79796, H-01092, H-04923, H-05004, H-26742, H-39627, H-42907, H-49434
KILNS A-02653, A-06371, A-09214, A-09541, A-09651, A-09692, A-17344, A-17377, A-28652, A-31134, A-34096, A-36212, A-37752, A-39460, A-40159, A-42677, A-43272, A-49852, A-58370, A-60421, A-61183, A-69353, A-70069, A-79774, B-02962, B-19177, B-30814, B-32231, B-37164, B-44121, B-44838, B-48879, B-52445, B-53868, B-55678, B-56591, B-63775, B-66947, B-70537, C-17098, C-35956, C-38905, C-46443, C-55858, C-60278, C-60410, D-49860, G-12987, H-05421, H-08884, H-19147, H-29403, H-29597, H-30142, H-31733, H-36998, H-38568, H-39537, H-46733, H-50415, H-64824, H-68122, H-80575, L-09677, L-67888, N-21287, N-69692
KONIMETERS C-22877
KRAFT (SULFATE) PULPING A-03129, A-26254, A-36377, A-40344, A-45858, A-46558, A-47963, B-44979, B-45544, B-45707, B-47731, C-35956, D-09658, D-33108, J-48171, K-51212, L-20273, L-37747, L-47380

L

LABORATORY ANIMALS A-00375, A-00640, A-02312, A-11916, A-81169, B-02541, C-00126, C-01793, C-07719, G-00165, G-01047, G-01426, G-01794, G-02539, G-03246, G-03394, G-04734, G-04927, G-06288, G-07013, G-07917, G-08030, G-08031, G-08201, G-10247, G-10333, G-10362, G-11000, G-12282, G-12403, G-13215, G-13700, G-14126, G-14319, G-16047, G-18809, G-21455, G-23711, G-24392, G-28041, G-30145, G-30385, G-30387, G-30841, G-32256, G-32596, G-32601, G-32606, G-33276, G-33505, G-33510, G-33511, G-33561, G-33872, G-36411, G-36723, G-39799, G-39810, G-39813, G-39924, G-39931, G-40635, G-41036, G-41685, G-41686, G-41687, G-41688, G-43277, G-44593, G-44594, G-45055, G-45683, G-49223, G-52147, G-52686, G-57024, G-59073, G-61467, G-72961, G-74821, H-00600, H-00944, H-01092, H-03116, H-04544,

H-12540, H-12551, H-12553, H-12556, H-39627, H-39895, H-42857, H-54597, K-03582, N-04212
LABORATORY FACILITIES A-11916, A-48116, C-07710, C-09983, I-00695
LACHRYMATION C-67116, G-08031
LACQUERS A-37190, I-40833
LAKES B-28502, E-29910, E-43424
LAND USE PLANNING A-48849, H-48022, H-50415, H-72762, L-46561, N-65407
LANDFILLS A-22875, A-47048, A-50381
LAPSE CONDITION A-44566
LARYNGITIS G-11942
LASERS C-49879, C-50337, C-79842, C-80227, F-46162
LATIN AMERICA A-43403, G-44590, G-44867, G-49756
LAUNDRIES N-04212
LEAD A-00375, A-30447, A-42676, A-43014, A-45858, A-55212, A-60728, B-48811, C-09770, C-09983, G-11467, H-08884, H-11157, H-32291, H-48167, H-50959, I-00695, I-40510, I-46606, J-30696, K-08420, K-36823, L-06734, L-35795, L-37747, L-59722
LEAD ALLOYS A-30447
LEAD CHLORIDE L-84415
LEAD COMPOUNDS A-00375, A-09785, A-23561, A-27595, A-29786, A-30447, A-30517, A-31315, A-34018, A-37190, A-37721, A-40344, A-42054, A-43014, A-45145, A-47143, A-47959, A-48849, A-49924, A-50938, A-51100, A-52741, A-57231, A-59494, A-60421, A-60729, A-60866, A-66977, A-71477, A-73078, A-74262, A-75077, A-76638, A-80238, A-80334, A-80994, A-81343, A-81931, B-18826, B-45380, B-45707, B-45757, B-50868, B-58879, B-65640, B-72139, B-75387, B-77838, B-80950, C-06112, C-09983, C-11626, C-23096, C-23657, C-24603, C-26707, C-27294, C-28126, C-29771, C-32476, C-32534, C-36125, C-35771, C-38670, C-39136, C-39516, C-39719, C-39762, C-41719, C-41763, C-42928, C-43985, C-45760, C-49509, C-49879, C-49992, C-50876, C-50936, C-53523, C-55789, C-61692, C-61851, C-61957, C-64779, C-72017, C-75339, C-82552, C-83442, D-28097, D-31396, D-33576, D-34008, D-36806, D-41979, D-49260, D-50307, D-50690, D-51929, D-60574, D-63186, D-69144, D-73286, D-76890, D-78193, D-83399, E-29910, E-77970, F-34948, G-11467, G-16345, G-18988, G-19148, G-26274, G-27379, G-31319, G-38616, G-38721, G-39833, G-43277, G-44867, G-46085, G-47807, G-49756, G-50419, G-50916, G-52029, G-55517, G-57701, G-60625, G-61146, G-66044, G-67440, G-68583, G-71484, G-71536, G-71933, G-73658, G-79848, G-80197, G-80857, H-04544, H-08884, H-11157, H-11452, H-13159, H-13474, H-19604, H-26055, H-26092, H-30225, H-32736, H-35880, H-38332, H-39328, H-40368, H-41699, H-42857, H-42924, H-43226, H-45467, H-47014, H-47286, H-48167, H-48193, H-48374, H-49316, H-50729, H-50959, H-51754, H-54297, H-54597, H-60760, H-61496, H-65103, H-65179, H-66715, H-67348, H-67453, H-68770, H-71078, H-76297, H-77325, H-79976, H-84290, J-30696, K-08420, K-10168, K-14772, K-19750, K-28466, K-33107, K-34063, K-36823, K-38197, K-41682, K-42039, K-44310, K-44377, K-46081, K-47672, K-51057, K-51212, K-58638, K-58899, K-60180, K-68224, K-69550, K-72145, K-72151, K-74109, K-79255, K-80854, L-06734, L-17472, L-25542, L-28349, L-29421, L-30620, L-32789, L-32884, L-33495, L-35795, L-38669, L-41455, L-42188, L-42873, L-47380, L-48719, L-64940, L-76965, L-82278, L-84415, N-04212, N-17260, N-46820
LEAD PRIMARY SMELTING AND REFINING B-83134
LEATHER I-07553, I-24308, I-27060
LEAVES A-02312, A-12095, A-13615, A-31144, A-31935, A-48048, A-61564, A-83543, B-02541, B-09664, C-00260, C-00636, C-01349, C-05586, C-06398, C-11915, C-18016, C-18230, C-18264, C-24966, C-28441, C-28462, C-39762, C-43981, C-44174, C-44177, C-61896, D-09590, D-26026, D-28188, D-32666, D-53889, D-71272, D-77485, D-84625, E-70747, G-01338, G-01674, G-01728, G-48030, G-50318, H-00240, H-00266, H-00301, H-00631, H-00633, H-00788, H-00920, H-01250, H-01506, H-01557, H-01664, H-01705, H-01800, H-01809, H-02200, H-02379, H-03395, H-03612, H-03766, H-03860, H-03873, H-04683, H-04728, H-04732, H-04816, H-04904, H-04984, H-05398, H-05399, H-05485, H-06404, H-07047, H-08884, H-10342, H-10673, H-11157, H-11456, H-11466, H-11650, H-12042, H-14247, H-15404, H-15501, H-15838, H-16222, H-16472, H-16894, H-16896, H-17449, H-18266, H-18704, H-19124, H-19147, H-19358, H-19539, H-19656, H-19657, H-19949, H-20158, H-20573, H-21500, H-21501, H-21687, H-22084, H-22085, H-22092, H-22284, H-22624, H-22887, H-22930, H-23188, H-23222, H-23386, H-23576, H-23794, H-23852, H-23950, H-23986, H-23988, H-24036, H-24330, H-24395, H-25273, H-25499, H-26691, H-26711, H-26717, H-26800, H-26861, H-27021, H-27030, H-27091, H-27785, H-27805, H-28149, H-28437, H-28477, H-28483, H-28600, H-28899, H-29277, H-29443, H-29597, H-29616, H-30142, H-30297, H-30473, H-30805, H-30806, H-31527, H-32282, H-32334, H-32343, H-32535, H-32539, H-32714, H-32771, H-32897, H-33089, H-33606, H-33906, H-34121, H-35613, H-35880, H-35964, H-36159, H-36742, H-36994, H-37346, H-38568, H-38754, H-39183, H-39190, H-39328, H-39363, H-39493, H-39932, H-39986, H-40202, H-40899, H-41189, H-41439, H-41698, H-41904, H-42923, H-42954, H-42958, H-44345, H-44411, H-44595, H-45007, H-45160, H-45474, H-45663, H-46051, H-46338, H-46719, H-46923, H-47014, H-47385, H-48291, H-48403, H-48556, H-48639, H-48941, H-50157, H-50163, H-50677, H-51109, H-51271, H-51470, H-51754, H-52096, H-52102, H-52574, H-52829, H-53370, H-53903, H-54066, H-54710, H-54910, H-56240, H-56428, H-56637, H-57475, H-57716, H-58506, H-58777, H-59327, H-60559, H-60560, H-60907, H-60913, H-60961, H-61410, H-62597, H-63167, H-63442, H-64166, H-64588, H-64824, H-64860, H-66714, H-68122, H-69800, H-69966, H-70487, H-70607, H-70752, H-71078, H-73518, H-74459, H-74588, H-74617, H-77329, H-77391, H-78058, H-78580, H-78956, H-79309, H-79338, H-79586, H-79972, H-80064, H-80067, H-80083, H-80189, H-80493, H-80575, H-82146, H-82435, H-82498, H-82520, H-83082, H-83145, H-83182, H-83258, H-83721, H-83723, H-83730, H-83854, H-83885, H-84048, H-84089, H-84558, H-84579, H-84650, K-07605
LEGISLATION A-00896, A-01687, A-02312, A-03129, A-03450, A-11453, A-20134, A-30517, A-32060, A-36377, A-38657, A-51282, A-65064, B-24033, B-29680, B-46050, B-49023, C-31115, C-45760, C-46034, C-49992, D-35764, G-71484, H-23624, H-38574, K-14772, K-34063, K-36823, K-38197, K-42039, K-44310, K-47672, K-58899, K-79255, L-06349, L-09677, L-17188, L-19064, L-20273, L-24122, L-28349, L-29421, L-29504, L-29598, L-29818, L-30620, L-32789, L-32884, L-35795, L-37747, L-38669, L-39306, L-39749, L-40461, L-41455, L-42188, L-42874, L-44054, L-47380, L-48719, L-60630, L-76847, L-76965, L-77817, L-80894, L-81399, N-12307, N-20040, N-50867
LETTUCE B-02541, H-00187, H-00265, H-00266, H-00301, H-01800, H-05724, H-17449, H-28437, H-30142, H-31208, H-45007, H-67026, H-84651
LEUKOCYTES A-06241, G-10203, G-13215, G-33872
LICHENS H-76233, H-78402, H-80189, H-84548
LIFE SPAN G-39931, H-51905
LIGHT REFRACTION C-66753, N-66750
LIGHT SCATTERING F-62189
LIGHT-DUTY VEHICLES A-00375, A-09785, A-12557, A-23561, A-23865, A-29786, A-31315, A-32060, A-34018, A-36377, A-42054, A-47143, A-48946, A-68703, A-69309, A-76274, B-02541, B-07549, B-35106, B-37402, B-47731, C-35108, D-27254, D-33108, D-34008, D-49860, D-73835, G-30788, G-31319, G-50161, H-45130, H-76297, I-23108, J-30696, K-19818, K-71991, K-72151, L-17472, L-19434, L-24122, L-27677, L-31492, L-32789, L-77234, N-04212, N-21287, N-32254
LIME KILNS A-17344, A-39460, A-40159, A-42677, A-43272, B-44121, B-44838, B-55678, B-63775, B-70537, C-35956, C-38905, C-55858, C-60278, C-60410, D-49860, H-08884, H-19147, H-31733, H-36998, H-39537, H-64824
LIME/LIMESTONE PROCESSES B-78814, B-79079
LIMESTONE A-09214, B-06587, B-10618, B-12288, B-22484, B-23182, B-24333, B-24355, B-28889, B-30276, B-37603, B-43863, C-23947, C-25816, G-08201, H-07255, H-24548, H-45160, H-80575, I-07553
LIPIDS G-36723, H-02382, H-10150
LIQUIDS A-39862, B-07552, B-26244, B-27282, B-29114, B-33971, B-38439, B-41932, B-46086, B-47054, B-47341, B-47821, B-49929, B-55524, B-66592, B-69528, B-71412, B-76512, B-79711, C-01793, C-04463, C-15355, C-25806, D-33425, F-13998, F-19175, F-21632,

F-34948, F-62189, G-06485, G-26743, G-28019, G-37569, G-37795, G-43896, G-45055, H-22496, H-28031, H-33290, H-37403, H-46923, H-64427, I-00085, I-07553, I-40510
LITHIUM COMPOUNDS A-52741, A-75077, B-12465, B-38445, C-75339, F-04468, F-21632, G-71933
LITIGATION A-07650, H-36787, L-24010, L-25642, L-45783
LIVER A-81169, C-07719, G-03246, G-04849, G-04983, G-06288, G-07917, G-08030, G-08031, G-11000, G-21455, G-25946, G-28199, G-32601, G-32605, G-32606, G-33505, G-36751, G-41685, G-49223, G-54302, G-79619, H-04850, H-04923, H-05004, H-11452, H-39627, H-79633
LOCAL GOVERNMENTS B-72139, C-31115, D-35764, D-54881, K-42039, K-44310, L-09677, L-19064, L-20273, L-32884, L-33495, L-38669, L-41455, L-42188, L-59722, L-80894
LONDON A-00375, A-32060, C-16801, H-16244, N-04212, N-64545
LOS ANGELES A-00375, A-09785, A-33853, E-29774, G-28199, H-00301, H-01809, H-03629, H-06459, H-07255, H-11407, H-16244, H-27030, H-33089, H-33127, H-33468, I-00695, K-11414, K-38197, L-09677, L-17614, L-44054, N-04212, N-28923, N-63463
LOUISIANA A-00375, K-37472
LOWER ATMOSPHERE C-28374, C-29887, C-79843, D-28097, E-78933, E-79132, G-40597, H-32339, H-39183
LUBRICANTS A-37190
LUNG CANCER A-00375, A-22973, B-19177, G-07961, G-11942, G-16345, G-22628, G-27379, G-37791, G-39494, G-41706, G-48693, G-48697, G-73658, G-74290, H-42857, N-49170
LUNG CLEARANCE G-07013, G-10247, G-10362, G-30841, G-32256
LUNGS C-07719, G-00165, G-01047, G-02539, G-04849, G-04983, G-06288, G-07013, G-07344, G-07917, G-07961, G-08030, G-08031, G-08201, G-10247, G-10362, G-11000, G-11467, G-12532, G-18809, G-21455, G-25946, G-28429, G-28556, G-29415, G-30788, G-30841, G-31319, G-32256, G-32596, G-32605, G-32607, G-33276, G-33505, G-33511, G-33872, G-36751, G-40597, G-41684, G-41706, G-44867, G-48637, G-49164, G-49223, G-52686, G-57024, G-66668, G-79619, G-79623, G-79980, G-84260, H-04923, N-64545
LYMPHOCYTES G-10203, G-11000, G-43277

M

MAGNESIUM A-30517, C-09770, I-00085, I-40510
MAGNESIUM COMPOUNDS A-09785, A-09799, A-27617, A-32702, A-34096, A-42731, A-43403, A-51100, A-52741, A-64926, A-75077, A-79567, B-12465, B-28709, B-37603, B-38188, B-40381, B-40712, C-09560, C-42928, C-75339, C-83442, D-21419, E-43424, F-22219, F-34948, G-04145, G-26743, G-52029, G-84236, H-00979, H-08884, H-15213, H-16567, H-24282, H-26175, H-30368, H-39098, H-47806, H-52306, H-52651, H-60560, H-64824
MAGNETOHYDRODYNAMICS (MHD) F-44721
MAINTENANCE A-35985, A-37752, A-46925, A-48048, A-48429, A-60421, A-71262, B-18698, B-30276, B-31567, B-33918, B-33971, B-35448, B-35513, B-38115, B-43533, B-47677, B-48480, B-49477, B-50868, B-55046, B-60255, B-64977, B-66624, B-70428, B-73031, C-59814, J-30696
MANAGEMENT PERSONNEL D-26702, L-06754
MANGANESE A-11916, H-08884
MANGANESE COMPOUNDS A-09785, A-11916, A-27930, A-49617, A-51100, A-52741, A-57231, A-60866, A-61564, A-64926, A-74262, A-75077, A-80238, A-81169, A-81931, A-82279, B-12465, B-28709, B-40381, B-40712, C-09983, C-24359, C-28126, C-39136, C-39516, C-42928, C-43985, C-50936, C-53523, C-55789, C-61957, C-75339, C-82552, C-83442, D-17102, D-33017, D-33309, D-36806, D-49260, D-50307, D-51929, D-76890, D-83399, E-29910, E-43424, G-36723, G-38616, G-52029, G-71933, H-08884, H-13474, H-30368, H-35880, H-44345, H-48374, H-50959, H-51754, H-52306, H-60560, H-71078, K-10168, K-28466, K-41682, K-51057, K-68224, K-74109, L-44054
MANUAL C-07871, C-23546, C-26122, C-71232, C-80573
MANUFACTURING INDUSTRIES A-00896, A-01528, A-02312, A-02988, A-03129, A-05139, A-05140, A-05871, A-09214, A-09690, A-09695, A-09696, A-09785, A-09799, A-11541, A-11916, A-13353, A-13699, A-17344, A-17357, A-17464, A-17471, A-20134, A-22547, A-22973, A-23865, A-24370, A-25305, A-26136, A-26254, A-26258, A-26329, A-27314, A-27930, A-28282, A-29786, A-30447, A-30517, A-31283, A-31333, A-31935, A-32139, A-32855, A-33735, A-34018, A-35592, A-35985, A-36377, A-37752, A-37996, A-38657, A-39460, A-39635, A-40159, A-40180, A-40182, A-40344, A-41650, A-41877, A-42675, A-42682, A-42683, A-42751, A-43014, A-43270, A-43272, A-43816, A-44681, A-45858, A-46119, A-46558, A-47143, A-47954, A-47963, A-48429, A-49617, A-49924, A-53955, A-55212, A-55407, A-55601, A-58939, A-59775, A-60281, A-60283, A-60728, A-60827, A-63661, A-66977, A-67748, A-70069, A-70727, A-71262, A-71477, A-74512, A-75206, A-76122, A-76190, A-76411, A-76459, A-77367, A-77522, A-77993, A-79280, A-79511, A-79774, A-80334, A-81169, A-81745, A-81861, A-81916, A-81917, A-82269, A-82279, A-82353, A-82944, A-83637, A-84479, B-00368, B-04794, B-06587, B-07664, B-07815, B-10372, B-10615, B-15813, B-17485, B-18536, B-19210, B-20436, B-21034, B-21795, B-22598, B-22913, B-23182, B-24033, B-24117, B-24355, B-24683, B-25038, B-25433, B-25638, B-25658, B-26674, B-26908, B-26911, B-27569, B-27835, B-28034, B-28786, B-29680, B-32231, B-32232, B-32384, B-32627, B-32712, B-33918, B-36405, B-36475, B-36532, B-36716, B-37080, B-37115, B-37603, B-37745, B-37914, B-38587, B-39104, B-40251, B-40414, B-40892, B-41378, B-41418, B-42172, B-43108, B-43533, B-43863, B-43972, B-44716, B-44793, B-44979, B-45004, B-45078, B-45254, B-45564, B-45707, B-46086, B-47095, B-47125, B-47256, B-47731, B-48143, B-48811, B-48814, B-49023, B-49031, B-50435, B-51720, B-51755, B-52094, B-52838, B-52852, B-53603, B-53620, B-54310, B-55524, B-56057, B-58466, B-58632, B-59459, B-59679, B-60206, B-60282, B-61273, B-63474, B-64092, B-65923, B-66592, B-67136, B-67137, B-67742, B-70428, B-70658, B-70659, B-70840, B-71472, B-76232, B-77475, B-77816, B-79079, B-80213, B-80863, B-81040, B-81645, B-81772, B-81773, B-81944, B-81995, B-82918, B-83134, B-83198, B-84418, C-13056, C-14265, C-18230, C-20701, C-28530, C-29220, C-35956, C-36693, C-40211, C-40409, C-43570, C-61896, C-80935, C-82552, C-82650, C-84463, D-06809, D-09590, D-09658, D-24801, D-25093, D-28188, D-31371, D-33108, D-33858, D-37994, D-39737, D-40896, D-47982, D-48791, D-49260, D-49860, D-53889, D-56464, D-66083, D-70500, D-71272, D-83399, E-29315, E-37037, E-49433, E-59075, F-15927, G-04145, G-07098, G-11467, G-12547, G-12550, G-13040, G-15555, G-16874, G-25469, G-26846, G-28139, G-29415, G-30183, G-32607, G-33510, G-33511, G-36751, G-38106, G-39219, G-40527, G-40920, G-44362, G-44597, G-44867, G-47906, G-49271, G-50371, G-50414, G-56931, G-56933, G-62177, G-62596, G-64484, G-68583, G-74369, G-74822, G-79634, G-81181, G-83798, G-84233, H-08884, H-09553, H-10342, H-11650, H-12529, H-12538, H-12552, H-12553, H-12554, H-15838, H-18226, H-18270, H-18272, H-19656, H-20707, H-21422, H-23661, H-24330, H-24395, H-25499, H-27021, H-27030, H-28446, H-28830, H-28899, H-29277, H-29736, H-30301, H-32282, H-32291, H-32339, H-32588, H-32897, H-33290, H-33906, H-36787, H-38017, H-38404, H-38417, H-38574, H-39537, H-39627, H-39923, H-40201, H-40472, H-40599, H-44428, H-45007, H-45130, H-46217, H-46719, H-47385, H-49561, H-49647, H-50415, H-50959, H-52829, H-52994, H-53025, H-53370, H-54066, H-55066, H-56874, H-58777, H-58941, H-59935, H-60690, H-61000, H-65715, H-66983, H-70752, H-73518, H-74459, H-74624, H-77050, H-77377, H-77391, H-77421, H-79129, H-79633, H-79635, H-80064, H-80079, H-80083, H-80189, H-80575, H-81288, H-81771, H-82208, H-83258, H-83730, H-83851, H-83854, H-84080, H-84551, H-84553, I-07553, I-23108, I-39031, J-28805, J-29923, J-30226, J-30696, J-39910, J-48171, J-67865, J-76213, K-10168, K-51212, K-58899, K-66916, K-81864, K-84395, L-06754, L-09677, L-19434, L-20273, L-24010, L-29421, L-37747, L-37943, L-39749, L-40461, L-43007, L-47380, L-48788, L-77817, L-78484, L-81399, L-84415
MAPPING A-68912, E-37037, E-64013, H-58507, L-32354
MARYLAND D-56792, H-70487

MASS SPECTROMETRY A-48116, A-48572, A-49738, A-53955, A-75077, C-23907, C-31827, C-35956, C-39719, C-49391, C-53523, C-66753, C-67116, C-69765, C-71044, C-75339, C-79032, C-80495, D-52578, E-04987
MASS TRANSPORTATION A-47143
MATHEMATICAL ANALYSES A-23022, A-55407, A-75146, A-77993, B-09664, B-12465, B-29403, B-59459, B-71412, C-00941, C-11041, C-17117, C-27248, C-31827, C-44174, C-44285, D-22359, E-02325, E-29315, E-29774, E-44030, E-59234, E-79132, F-21632, G-05504, G-52638, H-04925, K-44377, K-69550, L-24122, N-17260, N-63463
MATHEMATICAL MODELING A-75146, B-09664, B-12465, B-29403, C-27248, C-44285, E-02325, E-29315, E-59234, L-24122, N-17260, N-63463
MAXIMUM ALLOWABLE CONCENTRATION A-00896, A-03129, A-17344, A-27930, A-31315, A-31333, A-33735, A-37190, A-37721, A-47410, A-47959, A-79511, B-19177, B-25135, B-25638, B-38476, C-41719, D-06809, D-24736, D-33576, D-37823, D-47982, D-54881, G-01794, G-06485, G-12282, G-32596, G-32601, G-32605, G-32606, G-33509, G-33510, G-33511, G-33561, G-34398, G-35569, G-36947, G-37139, G-38721, G-41684, G-41685, G-41686, G-41687, G-41688, G-50161, G-66668, G-71617, H-02379, H-23624, H-23986, H-29991, H-30297, H-40916, H-65558, K-11414, K-17375, K-19750, K-27010, K-28466, K-33107, K-34063, K-36823, K-41266, K-41267, K-41295, K-41682, K-51057, K-51212, K-51229, K-60180, K-60887, K-68582, L-06349, L-06734, L-06939, L-09677, L-29504, L-31492, L-32789, L-32884, L-35795, L-37747, L-38669, L-41455, L-44054, L-46586, L-78484
MBTH METHOD (ALDEHYDES) C-32476, C-43985
MEAT PACKING PLANTS A-26254, A-34018, A-43270, B-26911, B-44716, C-66753
MEAT PRODUCTS INDUSTRY A-26254, A-34018, A-43270, A-80334, B-26911, B-44716
MEDICAL FACILITIES G-10362
MEETINGS A-48849, D-30705, H-79338, K-38197, N-37027
MEMBRANE FILTRATION A-11877, C-04038, C-07871, C-11404, C-11574, C-12334, C-22517, C-22812, C-22877, C-23096, C-23657, C-24603, C-25180, C-26707, C-28285, C-28738, C-29426, C-30958, C-32476, C-34125, C-37579, C-39022, C-40409, C-41624, C-42926, C-44083, C-44238, C-48674, C-48916, C-49992, C-56244, C-61957, C-64090, C-71244, C-71245, C-74234, C-76212, D-30058, D-33858, D-39182, D-52578, D-58427, D-66083, F-34948, H-24362, N-64545
MEMBRANES C-36771, C-37579, G-30841, G-43636, G-44590, G-44594, G-79623, G-84233, H-00654, H-23624, H-39363, H-56625, H-80536, K-41295
MERCAPTANS A-20134, A-26254, A-39460, A-44566, A-45145, A-71262, B-08344, B-14692, B-26908, B-45707, C-35956, C-39136, C-39719, C-47218, C-71044, D-31371, D-33425, D-41979, E-04987, G-41706, H-05421, H-45022, H-51526, I-58585, K-72151, L-29504, N-65407
MERCURY F-21389, L-37747
MERCURY COMPOUNDS A-09695, A-11590, A-11876, A-12773, A-12889, A-23561, A-39460, A-47959, A-57231, A-59257, A-73078, A-74262, A-75077, A-76638, A-80238, A-80994, A-81343, B-18826, B-32461, B-45707, B-48805, B-55180, B-62165, B-75204, B-75387, B-77838, B-79711, B-80950, C-09560, C-11626, C-28126, C-32476, C-32534, C-38670, C-39136, C-39516, C-44285, C-46034, C-50936, C-51762, C-53523, C-55789, C-61957, C-75339, C-82552, C-83442, C-84660, D-31371, D-62438, F-44721, G-39833, G-46085, G-50419, G-50916, G-57701, G-71933, G-73658, G-79848, G-80197, H-04984, H-13474, H-17710, H-20158, H-36159, H-36742, H-40202, H-42857, H-42923, H-45022, H-48374, H-50780, H-67056, H-67457, K-10168, K-28466, K-41682, K-68224, L-44054
METABOLISM B-26911, F-28428, G-01674, G-04983, G-06497, G-10842, G-12403, G-14126, G-26461, G-28037, G-36723, G-38106, G-40920, G-41685, G-41688, G-48068, G-49448, G-49607, G-50371, G-51473, G-59073, G-79623, H-00654, H-00737, H-00920, H-02200, H-02382, H-04728, H-04919, H-04923, H-05004, H-05398, H-05399, H-05744, H-07046, H-10841, H-10843, H-11100, H-16399, H-19656, H-19657, H-19703, H-20400, H-21000, H-22496, H-23624, H-23950, H-23988, H-24366, H-24533, H-24852, H-26717, H-27785, H-29616, H-30234, H-30805, H-30806, H-31124, H-33716, H-34880, H-35877, H-36159, H-37403, H-38332, H-38568, H-40341, H-41189, H-41362, H-41699, H-42924, H-46719, H-58506, H-59198, H-66714, H-68575, H-69488, H-79972
METAL COMPOUNDS A-00375, A-04068, A-05601, A-06241, A-09214, A-09541, A-09695, A-09697, A-09785, A-09799, A-11590, A-11876, A-11916, A-12095, A-12476, A-12773, A-12889, A-12919, A-17471, A-17883, A-18449, A-23561, A-26258, A-27314, A-27595, A-27617, A-27930, A-29532, A-29786, A-30296, A-30447, A-30517, A-31315, A-32060, A-32702, A-33853, A-34018, A-34096, A-35592, A-37190, A-37721, A-37752, A-39460, A-39587, A-40180, A-40182, A-40344, A-42054, A-42677, A-42682, A-42731, A-43014, A-43272, A-43403, A-45145, A-47048, A-47143, A-47959, A-48849, A-49617, A-49852, A-49924, A-50381, A-50938, A-51100, A-52741, A-53955, A-54622, A-55212, A-57231, A-59257, A-59494, A-59921, A-60421, A-60728, A-60729, A-60866, A-61564, A-61570, A-64926, A-66977, A-71262, A-71477, A-73078, A-74154, A-74262, A-75077, A-75089, A-76411, A-76638, A-79567, A-80238, A-80334, A-80994, A-81169, A-81343, A-81931, A-82279, B-10372, B-11636, B-12127, B-12465, B-18536, B-18826, B-21034, B-22598, B-24110, B-24117, B-24355, B-25178, B-25433, B-25658, B-28709, B-28783, B-28786, B-28889, B-28945, B-29114, B-30276, B-30519, B-30814, B-31708, B-31889, B-32384, B-32461, B-32963, B-36532, B-36716, B-37509, B-37603, B-38188, B-38439, B-38445, B-38504, B-38593, B-40381, B-40712, B-41418, B-42172, B-42287, B-43299, B-43863, B-43972, B-45380, B-45707, B-45757, B-46086, B-47086, B-47186, B-47256, B-48480, B-48805, B-48879, B-49023, B-49929, B-50652, B-50868, B-53620, B-55180, B-55678, B-56064, B-56528, B-56591, B-58380, B-58879, B-58993, B-59459, B-59861, B-60075, B-60255, B-61954, B-62165, B-62786, B-64898, B-65640, B-66947, B-70428, B-72139, B-75204, B-75387, B-77838, B-79711, B-80950, B-81645, B-84391, C-00264, C-02042, C-04495, C-04463, C-04687, C-04692, C-06112, C-06279, C-06494, C-07710, C-07860, C-09560, C-09770, C-09983, C-10632, C-11626, C-12593, C-12760, C-13056, C-16801, C-23096, C-23517, C-23573, C-23657, C-2368[illegible], C-24018, C-24022, C-24050, C-24114, C-24124, C-24279, C-24310, C-24331, C-24359, C-24456, C-24546, C-24603, C-24966, C-24970, C-25223, C-25617, C-25932, C-26707, C-26729, C-26744, C-27248, C-27294, C-27331, C-28126, C-28251, C-29738, C-29771, C-29887, C-30793, C-32476, C-32534, C-33632, C-34125, C-36125, C-36771, C-37799, C-38280, C-38670, C-39136, C-39516, C-39719, C-39762, C-41020, C-41063, C-41064, C-41719, C-41763, C-42928, C-43234, C-43981, C-43985, C-44083, C-44177, C-44285, C-45760, C-46034, C-46443, C-48674, C-49509, C-49752, C-49879, C-49992, C-50876, C-50936, C-51762, C-53523, C-55789, C-61692, C-61851, C-61859, C-61957, C-64779, C-69152, C-72017, C-74346, C-75339, C-80103, C-80227, C-82552, C-82650, C-83442, C-84660, D-09590, D-17102, D-21419, D-23845, D-27254, D-28097, D-30058, D-31371, D-31396, D-33017, D-33309, D-33576, D-33858, D-34008, D-36806, D-39182, D-39737, D-40896, D-41979, D-43317, D-49260, D-49860, D-50307, D-50690, D-51929, D-52578, D-54881, D-56463, D-56464, D-56465, D-58427, D-60574, D-62438, D-63186, D-69144, D-73286, D-76890, D-78193, D-83399, E-29910, E-33092, E-33579, E-40271, E-43424, E-62869, E-77970, F-04468, F-13998, F-21632, F-22219, F-26990, F-34948, F-41543, F-44721, G-00165, G-01794, G-03246, G-03394, G-04145, G-04927, G-06485, G-07098, G-07344, G-07961, G-10203, G-10247, G-10362, G-11000, G-11467, G-14126, G-16345, G-16874, G-18809, G-18987, G-18988, G-19148, G-23563, G-23763, G-26274, G-26743, G-26846, G-27379, G-28139, G-28199, G-28429, G-28556, G-31319, G-32152, G-32256, G-32605, G-32606, G-33276, G-33505, G-33561, G-33872, G-34398, G-36723, G-38616, G-38721, G-39799, G-39810, G-39813, G-39833, G-41686, G-41687, G-43277, G-44867, G-46085, G-47807, G-48636, G-48637, G-49271, G-49756, G-50161, G-50419, G-50916, G-52029, G-52638, G-54302, G-54968, G-55517, G-57701, G-60625, G-61146, G-61467, G-66044, G-67440, G-68583, G-71484, G-71536, G-71933, G-72961, G-73658, G-79848,

G-30197, G-30857, G-84137, G-84236, H-00137, H-00301, H-00631, H-00979, H-02200, H-02382, H-03360, H-03860, H-03873, H-04544, H-04672, H-04683, H-04919, H-04925, H-04984, H-04997, H-05004, H-06342, H-06354, H-06681, H-08884, H-10342, H-10841, H-10843, H-11157, H-11452, H-13159, H-13213, H-13474, H-15213, H-15938, H-16150, H-16567, H-17710, H-18269, H-18271, H-19539, H-19604, H-20158, H-22092, H-24282, H-24395, H-24548, H-24787, H-24944, H-25366, H-25499, H-25661, H-25665, H-25750, H-26055, H-26092, H-26175, H-26800, H-27907, H-28409, H-28443, H-28446, H-28475, H-29443, H-29597, H-30225, H-30368, H-32539, H-32673, H-32736, H-33606, H-35880, H-35992, H-36159, H-36742, H-36998, H-37346, H-38332, H-38404, H-38407, H-39098, H-39328, H-39902, H-40202, H-40368, H-41699, H-42857, H-42923, H-42924, H-42958, H-43226, H-43492, H-43622, H-44345, H-45022, H-45160, H-45345, H-45467, H-46719, H-46721, H-47014, H-47286, H-47806, H-48167, H-48193, H-48374, H-48413, H-49316, H-49778, H-50729, H-50780, H-50959, H-51526, H-51754, H-52306, H-52397, H-52651, H-52928, H-54297, H-54597, H-56788, H-60560, H-60760, H-60961, H-61496, H-62597, H-63442, H-64824, H-65103, H-65179, H-66715, H-67056, H-67347, H-67348, H-67453, H-67457, H-68770, H-70279, H-71078, H-71098, H-76297, H-77325, H-79976, H-80067, H-83145, H-83721, H-84290, I-07553, I-08076, I-27060, I-40510, I-40833, I-47291, I-58585, J-30696, K-08420, K-10168, K-14772, K-19750, K-28466, K-31968, K-33107, K-34063, K-36823, K-38197, K-41682, K-42039, K-44310, K-44377, K-46081, K-47672, K-51057, K-51212, K-58638, K-58899, K-60180, K-68224, K-68582, K-69550, K-72145, K-72151, K-74109, K-79255, K-80854, L-06349, L-06734, L-17472, L-20273, L-25542, L-27677, L-28349, L-29421, L-29504, L-29818, L-30620, L-32789, L-32884, L-33495, L-35795, L-38669, L-41455, L-42188, L-42873, L-44054, L-47380, L-48719, L-50180, L-52026, L-64940, L-76847, L-76965, L-80894, L-82278, L-84415, N-04212, N-17260, N-46820, N-63463, N-66750

METAL FABRICATION A-05871, A-82279, B-41418, B-44979, G-81181, H-80083

METAL INDUSTRIES A-00896, A-01528, A-05871, A-17344, A-17464, A-17471, A-30447, A-31333, A-32139, A-37752, A-38657, A-39635, A-40182, A-40344, A-41877, A-42682, A-43014, A-43272, A-45858, A-49617, A-74512, A-75206, A-76122, A-76190, A-77522, A-81861, A-82269, A-82353, A-82944, A-83637, B-04794, B-06587, B-07664, B-10618, B-23182, B-24683, B-25433, B-25638, B-25658, B-29680, B-40892, B-41378, B-42172, B-43108, B-44979, B-45544, B-76232, B-77475, B-80213, B-81645, B-81995, B-82918, B-83134, B-83198, C-80935, C-82552, D-39737, D-40896, G-40920, G-74369, G-74822, G-83798, G-84233, H-29736, H-40599, H-73518, H-74459, H-77050, H-77377, H-77391, H-77421, H-79129, H-79633, H-80064, H-80189, H-82208, H-83258, H-83730, H-83851, H-84080, H-84551, H-84553, J-29923, J-76213, K-81864, K-84395, L-09677, L-19434, L-78484, L-81399

METAL POISONING G-04145, G-11467, G-44867, G-49756, G-56933, G-61146, H-04544, H-08884, H-23624, H-26092, H-32291, H-32736, H-60760, H-66715, H-67453, H-68770, H-76297, K-31968

METALS A-00375, A-01687, A-03129, A-05090, A-05601, A-06241, A-07650, A-08102, A-08748, A-09799, A-11341, A-11877, A-11916, A-12470, A-12474, A-12476, A-12587, A-12622, A-12676, A-12692, A-12740, A-13615, A-13701, A-17116, A-17471, A-18656, A-23022, A-24370, A-26136, A-30296, A-30447, A-30517, A-31283, A-31333, A-31935, A-34018, A-35592, A-38657, A-39460, A-40159, A-40180, A-40182, A-41650, A-41877, A-42676, A-42680, A-42682, A-42683, A-42731, A-42751, A-43014, A-44490, A-44605, A-45858, A-47061, A-47962, A-49617, A-49886, A-49924, A-50018, A-52912, A-53874, A-55212, A-55407, A-58939, A-59775, A-60728, A-60866, A-61564, A-64926, A-67806, A-68807, A-68823, A-69039, A-75077, B-04368, B-04794, B-05567, B-06587, B-07664, B-07815, B-08344, B-09902, B-10618, B-13676, B-15372, B-16962, B-17463, B-17485, B-18144, B-18641, B-18698, B-18699, B-19210, B-19487, B-22853, B-23182, B-23370, B-24116, B-25135, B-25195, B-26279, B-26317, B-28020, B-28786, B-30519, B-31567, B-32627, B-32712, B-32963, B-33918, B-35111, B-35513, B-36552, B-36755, B-37293, B-37544, B-37603, B-38082, B-38188, B-38445, B-38593, B-38775, B-38874, B-40414, B-40892, B-41418, B-42287, B-43108, B-43299, B-43840, B-44343, B-44638, B-44838, B-45078, B-45380, B-47125, B-47256, B-47463, B-47677, B-48805, B-48811, B-48814, B-49477, B-49929, B-50652, B-51755, B-51845, B-52094, B-52172, B-52179, B-52838, B-53603, B-53620, B-53875, B-54310, B-55524, B-56057, B-56528, B-57706, B-58380, B-58879, B-58993, B-59459, B-59679, B-60206, B-60255, B-60864, B-61273, B-67954, B-69191, B-70659, B-73031, C-02042, C-04038, C-09770, C-09983, C-10632, C-17098, C-28530, C-29220, C-29738, C-30793, C-30958, C-38905, C-40409, C-40705, C-41064, C-43570, C-44689, C-49391, C-49476, C-52206, C-53625, C-58842, C-60951, C-68086, C-75339, D-07579, D-09590, D-09658, D-13838, D-14066, D-17642, D-27254, D-32666, D-33108, D-33309, D-33858, D-37823, D-39182, D-39737, D-48791, D-49260, D-49860, D-53889, D-63526, D-66083, E-14897, E-37013, E-37639, E-49433, E-59075, E-64013, F-21389, F-32952, F-39861, G-00165, G-01096, G-07098, G-10203, G-10333, G-11000, G-11467, G-13215, G-13700, G-14112, G-14319, G-15040, G-19215, G-19880, G-23003, G-26846, G-28556, G-28754, G-29415, G-30183, G-31319, G-33766, G-37282, G-37569, G-37684, G-38106, G-38942, G-39799, G-40527, G-40635, G-40920, G-44362, G-47906, G-48697, G-49271, G-50371, G-50414, G-56931, G-56933, G-62177, G-62596, G-64484, G-66044, G-68520, H-00979, H-03116, H-08884, H-09553, H-10342, H-11157, H-13203, H-14678, H-15604, H-18269, H-18270, H-18704, H-19124, H-19358, H-20872, H-21062, H-21422, H-22085, H-22092, H-22496, H-22930, H-23386, H-23579, H-23580, H-26978, H-29277, H-32282, H-32286, H-32289, H-32291, H-32344, H-32516, H-32535, H-32536, H-32539, H-32672, H-32673, H-32897, H-33906, H-36883, H-36996, H-37480, H-38017, H-38404, H-38417, H-38[illegible], H-39159, H-39684, H-39895, H-399[illegible], H-40201, H-40472, H-40599, H-44428, H-45604, H-45663, H-46217, H-46719, H-46721, H-48167, H-49561, H-50959, H-52829, H-52994, H-53025, H-58506, H-58777, H-58941, H-60690, H-61000, H-65715, H-77377, I-00085, I-00695, I-07553, I-08076, I-23108, I-24308, I-27060, I-39031, I-40510, I-40833, I-46606, I-54961, I-58585, I-63871, I-65935, I-69995, J-29923, J-30696, J-39910, J-48171, K-08420, K-36823, K-51212, K-66860, L-06349, L-06734, L-06754, L-20273, L-24010, L-28014, L-29598, L-35795, L-37747, L-38573, L-39749, L-45783, L-46561, L-46586, L-59722, L-66700, N-14783, N-21287

METEOROLOGICAL INSTRUMENTS A-31581, C-09770, C-26713, C-35956, C-48392, D-01872, E-04987, H-46557

METEOROLOGY A-00220, A-00375, A-02312, A-03450, A-06241, A-07650, A-08882, A-09785, A-23561, A-28652, A-30218, A-31144, A-31315, A-31581, A-32060, A-32576, A-32702, A-34334, A-37190, A-44566, A-46119, A-47061, A-48048, A-50018, A-66955, A-68703, A-74154, A-76274, A-79511, A-80507, B-10618, B-19571, B-25195, B-26911, B-28034, B-38775, B-42083, B-45468, B-48480, B-61741, C-00126, C-06279, C-06338, C-07710, C-09770, C-10632, C-18344, C-22877, C-23286, C-26713, C-28251, C-29771, C-29887, C-35956, C-36693, C-36800, C-39239, C-39243, C-42926, C-44177, C-44285, C-48392, C-51599, C-65118, C-65846, C-66606, C-68944, C-69174, D-01872, D-09590, D-21419, D-22348, D-23760, D-23845, D-23862, D-24717, D-26086, D-26702, D-29040, D-30705, D-31371, D-32666, D-33017, D-33108, D-33309, D-33858, D-34008, D-36806, D-37502, D-39054, D-39182, D-39737, D-40896, D-41979, D-43170, D-43317, D-44267, D-44799, D-48791, D-49860, D-50550, D-50744, D-54881, D-56792, D-58218, D-58427, D-69144, D-70500, D-71348, D-73835, D-77485, E-02325, E-04987, E-05054, E-14897, E-29023, E-29774, E-29910, E-30126, E-33092, E-37013, E-37037, E-37639, E-40271, E-43424, E-44277, E-49433, E-59075, E-59234, E-72995, E-76047, E-78793, E-78933, G-01674, G-01794, G-12555, G-18785, G-18987, G-19148, G-23763, G-26274, G-32607, G-33510, G-34398, G-38616, G-39219, G-40597, G-41706, G-48030, G-49756, G-68583, G-74369, H-00301, H-05724, H-08884, H-10673, H-11157, H-11452, H-16567, H-19147, H-19539, H-20917, H-22930, H-23222, H-23295, H-23386,

H-23852, H-24064, H-24282, H-25273, H-25661, H-25750, H-25769, H-26055, H-26711, H-27030, H-28149, H-28446, H-28474, H-28476, H-28479, H-28647, H-28899, H-30301, H-31527, H-31733, H-32535, H-32536, H-32714, H-33290, H-33716, H-36994, H-36996, H-36998, H-38412, H-38568, H-38574, H-39466, H-40202, H-40341, H-40472, H-41189, H-41696, H-42601, H-42923, H-42924, H-42954, H-42958, H-45007, H-45160, H-46198, H-46923, H-47014, H-48798, H-51470, H-52705, H-53376, H-55654, H-56240, H-56428, H-58777, H-60907, H-60961, H-61000, H-62597, H-64427, H-68394, H-69162, H-70984, H-80064, H-82435, I-00695, I-07553, I-24308, I-27060, I-40833, I-46606, I-47291, I-52320, I-54961, J-32706, J-44672, J-55161, K-10168, L-17614, L-25542, L-39306, L-40889, L-64940, N-04212, N-28923, N-44066, N-46820, N-49170, N-51942, N-63776, N-69692

METHANES A-18449, A-40600, A-49738, B-79711, C-39719, C-41719, C-50337, C-66753, C-80103, F-16218, G-28041, G-30145, G-79848, G-84260, H-36742, L-29818, N-20495, N-66750

METROPOLITAN AREAS A-00220, A-08882, A-09785, A-11453, A-13615, A-22973, A-23865, A-25305, A-31315, A-32060, A-32855, A-34334, A-36377, A-37190, A-37996, A-40471, A-42054, A-46558, A-47061, A-47143, A-47945, A-52277, A-52664, A-55922, A-58334, A-66955, A-66977, A-72079, A-76274, A-80334, B-28502, B-38476, B-44638, B-45468, B-84391, C-11915, C-12334, C-18344, C-20701, C-22812, C-24222, C-25487, C-26713, C-31115, C-38905, C-39762, C-40705, C-44174, C-44177, C-44285, D-07579, D-09590, D-10619, D-17102, D-17986, D-18537, D-19145, D-19966, D-21419, D-22348, D-22359, D-23392, D-23845, D-24736, D-25093, D-26026, D-26086, D-27254, D-28097, D-28771, D-31371, D-31396, D-33080, D-33108, D-33309, D-33425, D-33576, D-34008, D-35764, D-36806, D-37473, D-37502, D-37607, D-37823, D-37994, D-39054, D-39182, D-39737, D-40896, D-41979, D-42760, D-43170, D-43317, D-44267, D-44799, D-47976, D-47982, D-48791, D-48850, D-49260, D-49860, D-50307, D-50550, D-50690, D-50744, D-51929, D-52575, D-52578, D-52811, D-53889, D-54881, D-55187, D-56792, D-58339, D-58427, D-63186, D-67690, D-71362, D-77512, D-78193, D-78954, D-79343, D-83399, E-29774, E-37639, E-49185, E-49433, E-72995, G-06675, G-10333, G-12282, G-12532, G-14477, G-18988, G-19215, G-19880, G-23763, G-26274, G-28199, G-28754, G-29043, G-29415, G-30183, G-30788, G-31234, G-32152, G-32596, G-32607, G-33766, G-34398, G-37282, G-37569, G-37791, G-38106, G-38616, G-38721, G-38942, G-40920, G-41706, G-44867, G-47905, G-47906, G-48030, G-48636, G-48697, G-49164, G-49271, G-50318, G-50371, G-50419, G-56931, G-56933, G-57701, G-61646, H-03116, H-08884, H-12533, H-12554, H-17163, H-17449, H-17697, H-18269, H-18507, H-18704, H-20573, H-20917, H-22930, H-23188, H-23295, H-24036, H-27030, H-27091, H-28437, H-29597, H-30142, H-32672, H-33127, H-35880, H-35964, H-36883, H-36994, H-36996, H-36998, H-37480, H-38574, H-39607, H-39627, H-39895, H-40472, H-41362, H-41904, H-41983, H-43226, H-45540, H-46198, H-46217, H-46733, H-46997, H-47385, H-48167, H-48193, H-48374, H-48377, H-48556, H-48941, H-50959, H-51109, H-51470, H-51484, H-51754, H-52574, H-54597, H-55066, H-56584, H-56637, H-56874, H-56885, H-57475, H-58506, H-58507, H-58777, H-58941, H-59327, H-70279, H-72762, H-73518, H-77050, H-82498, H-83258, H-84548, I-00695, I-46606, I-47291, I-52320, I-54961, I-58585, I-73616, J-30696, J-32706, J-60298, K-17375, K-33107, K-36823, K-38197, K-44310, K-46081, K-69550, K-80854, L-06349, L-09677, L-17614, L-29598, L-29818, L-31492, L-32354, L-33495, L-33722, L-35795, L-37747, L-37943, L-38573, L-38669, L-40889, L-41455, L-42021, L-42874, L-46561, L-60630, L-73836, L-80894, L-82278, L-83965, N-16400, N-32254, N-50748, N-63463, N-65407

MEUSE VALLEY A-00375, G-18785, G-30788, G-39219, G-40597, N-66750

MEXICO G-44867, G-49756

MICE A-00375, C-07719, G-01426, G-03394, G-04927, G-07917, G-08031, G-10333, G-14319, G-28041, G-30841, G-40635, G-41036, G-44594, H-04544

MICHIGAN D-37473, D-42760, D-49860, H-02200, L-09677, L-17614

MICROMETEOROLOGY A-23561, B-45468, C-36693, C-48392, D-33108, E-14897, E-29910, H-00301, H-16567, H-22930, H-36994, H-39466, H-42923, H-51470

MICROORGANISMS A-00375, A-32702, B-28502, C-22812, C-35956, C-43981, D-19966, D-29040, F-28428, F-52013, G-01794, G-02539, G-07098, G-30788, G-61467, H-00137, H-00240, H-12042, H-16617, H-17705, H-21501, H-32334, H-33127, H-38568, H-40341, H-45214, H-45776, H-46338, H-51526, H-56241, H-57859, H-60559, H-62275, H-67348, H-80575, H-84484, I-07553, K-74109

MICROSCOPY B-13771, C-00264, C-23657, C-23907, C-43234, F-15927, G-01047, G-04145, H-00265, H-01664, H-07047, H-18226, H-22284, H-56625, I-00695, I-08076

MIDDLE ATMOSPHERE C-79843, E-40271, E-77970

MILK A-28282, A-37190, C-18264, G-12547, G-47807, H-01092, H-04997, H-09553, H-13203, H-29277, H-31208, H-32291, H-37480, H-46997, H-48167, H-48193, H-49316, H-61000

MINERAL PROCESSING A-02312, A-02988, A-04068, A-05090, A-05871, A-09541, A-09693, A-09694, A-09697, A-12095, A-15452, A-17344, A-17377, A-21380, A-22875, A-23865, A-26136, A-26254, A-30296, A-30447, A-30517, A-31144, A-31333, A-31581, A-31935, A-32139, A-32702, A-33735, A-34018, A-36377, A-37190, A-38657, A-39460, A-40159, A-40344, A-42677, A-43272, A-45858, A-46558, A-47143, A-47188, A-47954, A-47962, A-47965, A-48048, A-49852, A-49924, A-51137, A-52277, A-52664, A-58334, A-58370, A-58402, A-60729, A-60866, A-66977, A-68703, A-69353, A-76152, A-76644, B-02962, B-07190, B-09902, B-10372, B-19177, B-19210, B-24834, B-30814, B-37164, B-43481, B-43863, B-44793, B-44979, B-45078, B-46050, B-51845, B-52445, B-53603, B-53867, B-55678, B-56591, B-61935, B-63540, B-63775, B-64428, B-65640, C-12100, C-23683, C-26729, C-30432, C-46443, C-49391, C-60951, C-61896, C-68086, D-25093, D-41979, D-42760, D-47982, D-49860, D-52811, E-37037, G-04734, G-06485, G-06675, G-07098, G-07344, G-07961, G-11467, G-12532, G-24392, G-26846, G-37791, G-73658, H-05421, H-11157, H-16567, H-20707, H-23624, H-23874, H-27021, H-29443, H-29597, H-32344, H-35880, H-36998, H-38017, H-38404, H-38417, H-39493, H-39537, H-40201, H-42601, H-43492, H-45130, H-52651, H-65715, J-30696, J-39910, J-48171, K-34063, L-06939, L-09677, L-19434, L-25642, L-37747, L-39306, L-39749, L-40461, L-48788, N-63776

MINERAL WOOL N-66750

MINING A-02312, A-17344, A-22875, A-26254, A-30517, A-31581, A-40159, A-46558, A-47143, A-47188, A-47962, A-67940, A-75089, B-44979, C-23683, D-52811, D-78193, G-04734, G-07098, G-07344, G-07961, G-11467, G-37791, L-47380, L-48788

MISSILE AND SPACECRAFT LAUNCH VEHICLES A-00640, A-19400, A-27595, A-50242, B-42287, B-76008, C-06279, C-06494, C-07719, C-69152, E-02325, F-04468, G-01047, G-01096, G-11001, G-12403, H-16617, H-46051, H-57859

MISSOURI A-00640, C-00260, C-00626, C-01349, C-02565, D-24736, D-52578, F-01677, G-01096, G-04145, H-00265, H-00266, H-01705, I-00085, I-00695, L-09677

MIST ELIMINATORS B-82032, B-83198

MISTS A-04068, A-12476, A-12747, A-15452, A-18323, A-29532, A-31529, A-32702, A-34334, A-36045, A-40344, A-43014, A-60283, A-75089, B-05567, B-07190, B-07552, B-13771, B-18826, B-23310, B-24110, B-26745, B-27282, B-36532, B-38439, B-44979, B-45707, B-46086, B-70840, B-75204, C-10632, C-28671, C-35956, C-36693, C-43985, C-48392, D-28771, G-27379, G-28199, G-33510, G-33872, G-50916, G-73658, H-06395, H-35964, H-67026, I-58585, K-36823, K-51212, K-51229, L-29818, N-04212

MOLYBDENUM I-40510

MOLYBDENUM COMPOUNDS A-09785, A-49617, A-52741, A-76638, A-81343, C-82552, D-50307, D-69144, E-29910, G-27379, G-47807, G-52029, G-80857, H-04544, H-11452, H-13159, H-13474, H-28475, H-42924, H-43296, H-43492, H-48374, H-60760, I-08076

MONITORING A-02312, A-02847, A-03565, A-05040, A-05139, A-05140, A-05587, A-05601, A-08102, A-08116, A-08748, A-09214, A-09321, A-09332, A-09541, A-09651, A-09690, A-09692, A-09693, A-09694, A-09695, A-09696, A-09697, A-11341, A-11541, A-11590,

A-11876, A-12470, A-12474, A-12587, A-12676, A-12740, A-12741, A-12747, A-12749, A-12750, A-12773, A-12809, A-12813, A-12822, A-12828, A-12884, A-12886, A-12888, A-12889, A-12919, A-12929, A-12931, A-12933, A-13353, A-22875, A-30218, A-31144, A-31529, A-35985, A-40600, A-42751, A-45145, A-55922, A-59921, A-60283, A-65064, A-66977, A-67748, A-67834, A-68823, A-69353, A-70069, A-70727, A-74586, A-75206, A-76152, A-79043, A-81861, A-81916, A-81917, A-81931, A-81935, B-07664, B-24683, B-28034, B-29680, B-37293, B-42458, B-43533, B-49031, B-59459, B-70428, B-72139, B-75204, B-77816, C-01593, C-02681, C-03527, C-05078, C-05317, C-06112, C-06279, C-06397, C-06494, C-06983, C-07710, C-11041, C-11574, C-11678, C-11779, C-12451, C-12593, C-14288, C-15171, C-16109, C-16969, C-18696, C-20650, C-21855, C-21881, C-22458, C-22877, C-22879, C-23575, C-23767, C-23907, C-24118, C-24279, C-24372, C-24399, C-25223, C-25487, C-25647, C-26121, C-26122, C-26396, C-26692, C-26713, C-26981, C-27248, C-27294, C-27430, C-27769, C-28102, C-28671, C-29198, C-29426, C-29737, C-29738, C-30007, C-30958, C-31115, C-31712, C-32534, C-32643, C-35108, C-35737, C-35956, C-36002, C-36125, C-36693, C-37579, C-38280, C-38670, C-39022, C-39871, C-40211, C-40409, C-41489, C-41624, C-42375, C-42926, C-43570, C-43979, C-43986, C-44238, C-44253, C-44285, C-44689, C-45344, C-46034, C-47218, C-48392, C-48492, C-49391, C-49509, C-49752, C-49879, C-50337, C-50470, C-50876, C-51762, C-52206, C-52992, C-53876, C-53987, C-55367, C-55858, C-56572, C-56681, C-58278, C-59513, C-59814, C-60278, C-61103, C-63848, C-65118, C-65846, C-66606, C-68086, C-68944, C-69152, C-69174, C-69526, C-69675, C-69765, C-70638, C-73127, C-74221, C-74471, C-75058, C-79389, C-79842, C-80935, C-81439, C-82552, C-83442, C-83495, C-84463, D-01872, D-06809, D-09658, D-10619, D-22348, D-23845, D-26026, D-26702, D-30058, D-31396, D-34008, D-37502, D-37994, D-39737, D-40896, D-4267, D-44799, D-48850, D-49118, D-60574, D-63526, E-04987, E-59075, G-01096, G-10333, G-29807, G-30385, G-31234, G-33510, G-33561, G-41685, G-41686, G-41687, G-41688, G-43277, G-43896, G-52764, G-66044, H-01250, H-03549, H-06459, H-22789, H-28149, H-31448, H-32897, H-36742, H-41370, H-52409, H-52994, H-59947, I-00695, J-39910, J-42746, K-13173, K-26738, K-66860, K-80854, K-81864, L-17472, L-20273, L-24481, L-25542, L-27677, L-32354, L-33495, L-40889, L-52026, L-57270, L-59722, L-66700, L-73839, L-81220, L-82278, N-50867, N-65407

MONTANA A-48048, B-18144, H-45604, H-51484, H-52829, H-52994, H-58507, H-80535, K-51212

MONTHLY A-28652, A-49617, C-25816, D-09590, D-23845, D-26026, D-27254, D-30058, D-31396, D-33576, D-33858, D-37502, D-39054, D-39182, D-47982, D-48791, D-50744, E-49433, H-25499, H-30142, H-30297, H-38417, H-45160, H-70745, H-77325, K-19750

MORBIDITY D-47976, G-02539, G-03394, G-05833, G-06497, G-06675, G-07344, G-11942, G-16345, G-30841, G-36751, G-37791, G-38616, G-39833, G-49164, G-56933, G-57701, G-68520, G-74369, G-84137, H-04544, H-23624, H-56240, H-77391, H-84477

MORTALITY A-00640, A-27395, B-09664, C-72017, D-31396, D-37607, G-01047, G-03394, G-05833, G-07013, G-07961, G-16345, G-18809, G-18988, G-24580, G-30387, G-30841, G-33505, G-36723, G-36751, G-37791, G-38616, G-39799, G-39810, G-39813, G-39924, G-40597, G-41036, G-44593, G-44594, G-44867, G-48697, G-66044, G-74369, G-84260, H-04544, H-23624, H-51905, H-78681, H-84477, J-30226, N-46820

MOSSES H-76233

MOTTLING C-18230, G-03246, H-00633, H-01250, H-01800, H-03676, H-04732, H-04904, H-14968, H-17822, H-21687, H-22496, H-23188, H-30368, H-35964, H-38407, H-39902, H-39986, H-44595, H-54597, H-56625, H-57810

MOUNTAINS C-44177, D-31396, D-66083, G-68520, H-29991, H-45604

MOUTH G-10203, G-45055, H-04997

MULBERRIES H-80079, H-80493, H-82520, H-83145, H-83182, H-83258, H-83856, H-84080, H-84089, H-84527, H-84541, H-84545

MULTIPLE CHAMBER INCINERATORS B-29680

MUNICIPAL INCINERATORS A-81745, B-78890, B-81256

MUTAGENESIS C-67116, G-25160, G-37240, G-54968, G-57701, H-03729, H-06681, H-16900, H-25618, H-29010

N

NASHVILLE A-00375

NATIONAL AIR SAMPLING NETWORK (NASN) C-12334, D-24736, D-37473, D-50307, D-52575, D-55187, K-80854

NATIONAL GOVERNMENTS A-01528, A-03450, A-38657, C-45760, D-30705, D-56792, H-12045, K-14772, K-33107, K-47672, L-19064, L-24122, L-28349, L-29421, L-32884, L-33495, L-38669, L-40461, L-47380, L-48788, L-76397, L-76965, N-12307, N-21287

NATURAL EMISSION SOURCES A-32576, A-39862, A-40600, A-43403, A-49738, A-79567, A-82944, D-23862, D-66083, E-40271, E-77970, F-20932

NATURAL GAS A-04068, A-09785, A-40344, A-41877, A-45858, A-46925, A-47188, A-47410, A-59775, A-69353, B-35111, B-44793, B-60849, B-60864, B-71796, C-22812, D-09590, G-36751, H-08884, L-24122

NAUSEA G-16874, G-29043, G-84233

NECROSIS A-02988, A-46119, A-70727, C-00126, G-48030, G-51473, G-74290, H-00301, H-00631, H-00633, H-00979, H-01250, H-01506, H-01557, H-01800, H-02041, H-02049, H-02537, H-03395, H-03571, H-03873, H-04403, H-04678, H-04732, H-04816, H-04904, H-05398, H-05399, H-05667, H-06404, H-07047, H-10342, H-10673, H-13804, H-14247, H-14678, H-14968, H-15213, H-15838, H-16387, H-16472, H-16894, H-17109, H-17749, H-17822, H-19147, H-19539, H-19656, H-19949, H-20400, H-21687, H-22084, H-22092, H-22284, H-22624, H-23386, H-23575, H-23794, H-23852, H-23874, H-24852, H-25273, H-25499, H-26055, H-27303, H-27785, H-29277, H-29616, H-30298, H-30368, H-31733, H-32282, H-32339, H-32535, H-32536, H-32539, H-32771, H-32854, H-34121, H-36742, H-36994, H-38411, H-38568, H-39183, H-39466, H-39902, H-39986, H-41362, H-41439, H-41699, H-42958, H-45007, H-45540, H-46051, H-46338, H-46923, H-48403, H-50415, H-51109, H-51271, H-51470, H-52651, H-53903, H-54597, H-54910, H-56204, H-56240, H-56625, H-57810, H-58941, H-59184, H-60907, H-60913, H-60961, H-62597, H-63167, H-64166, H-64427, H-66714, H-68122, H-69966, H-70487, H-70607, H-74617, H-76451, H-76715, H-78580, H-80493, H-83797

NEEDLES H-78058, H-78580, H-80493, H-83082, H-84558, H-84579

NERVOUS SYSTEM A-00375, G-04983, G-12282, G-16874, G-28041, G-32601, G-32605, G-32606, G-33511, G-33561, G-36411, G-36723, G-36751, G-41224, G-41685, G-41688, G-44867, G-48068, G-49756, G-66668, G-74823, G-84260, H-04923, H-08884, H-41439, H-49434, H-66715

NETHERLANDS A-64926, C-59049, C-69526, C-69675, E-76047, E-78943, G-44590, H-39923, H-45214, H-46338, H-46557, H-54755, I-40833, I-46606, K-68582, L-46586

NETWORKS L-76397, L-81220

NEUTRON ACTIVATION ANALYSIS A-75077, C-11626, C-26952, C-28441, C-28462, C-43979, C-53523, C-69765, C-75339, D-33017, D-62438, E-43424, H-60595

NEW JERSEY A-07650, H-00301, H-01800, H-06395, H-67026, H-70984, H-80493, J-55161, L-09677, L-44598

NEW MEXICO H-48374

NEW ORLEANS A-00375

NEW YORK CITY A-00375, I-00695, K-38197, L-09677, L-17614, N-04212

NEW YORK STATE A-00375, H-06395, I-00695, K-27010, K-38197, L-06349, L-09677, L-17614, L-44054, L-44598, N-04212

NEW ZEALAND B-76232, H-76233

NICKEL C-09770, F-32952, H-08884, I-00085, I-08076, I-40510, I-40833, I-46606

NICKEL COMPOUNDS A-09785, A-27595, A-49617, A-51100, A-52741, A-57231, A-59257, A-74262, A-75077, A-76638, A-80238, A-81343, A-81931, A-82279, B-12465, B-75204, C-09560, C-39136, C-39516, C-42928, C-50936, C-55789, C-61957, C-75339, C-82552, D-50307, D-76890, E-29910, G-36723, G-39833, G-52029, G-71933, G-84137, H-08884, H-13474, H-48374, H-51754, H-67348, H-71078, H-77325, K-51057, K-68224, L-29504

NITRATES A-00375, A-12557, A-23561, A-39460, A-47143, A-48429, A-81931, B-18536, B-45254, B-55180, B-60075,

B-81040, B-84391, C-00126, C-04463, C-04687, C-04689, C-04692, C-04757, C-05892, C-22458, C-23096, C-35441, C-38280, C-43979, C-43985, C-49752, C-50337, C-50936, C-67116, C-80259, D-09590, D-23845, D-30058, D-33425, D-50307, D-50550, D-51929, D-55187, D-58218, E-76047, F-34948, G-01728, G-26274, G-27895, G-43277, G-52029, G-61146, G-73658, H-00654, H-00737, H-00979, H-01800, H-01809, H-02537, H-03472, H-05342, H-05485, H-07255, H-11157, H-12042, H-12045, H-12155, H-13474, H-14968, H-17749, H-19656, H-19713, H-20157, H-21364, H-23516, H-25865, H-26055, H-27303, H-28437, H-28474, H-28475, H-30473, H-31527, H-32714, H-33127, H-33468, H-41699, H-41983, H-44411, H-45214, H-45345, H-45533, H-45540, H-45557, H-45776, H-46198, H-46262, H-48639, H-49778, H-49779, H-50780, H-51321, H-51526, H-52102, H-52135, H-52409, H-52928, H-53903, H-54755, H-56655, H-63626, H-66714, H-67026, H-67056, H-67304, H-67348, H-67457, H-68575, H-68602, H-70776, H-70984, H-72762, H-76451, H-76452, H-84557, H-84651, I-69995, J-32706, J-43002, J-43547, J-44672, K-07605, N-20040, N-66718

NITRATION C-66753, N-66750

NITRIC ACID A-01125, A-03129, A-17076, A-23865, A-26254, A-30517, A-39460, A-42680, A-49924, B-07552, B-09773, B-32231, B-45254, B-45846, B-47680, B-54799, B-60864, B-69131, C-04458, C-22877, C-50337, C-79842, C-79843, D-43317, D-50744, H-18226, H-36742, H-39627, H-41362, H-41696, H-45022, I-40510, I-58585, K-37472, K-51057, K-60180, L-29818, L-48788

NITRIC ANHYDRIDE (N2O5) A-11916, F-04674, I-58585

NITRIC OXIDE (NO) A-00220, A-01125, A-09785, A-15452, A-17357, A-22875, A-23561, A-29532, A-29786, A-45145, A-61570, A-82279, B-07549, B-15322, B-20436, B-38504, B-42172, B-56531, B-61741, B-64898, B-68633, C-01349, C-05078, C-11574, C-17128, C-20030, C-20540, C-22517, C-22877, C-26122, C-29198, C-30840, C-32534, C-35108, C-38280, C-39719, C-43985, C-43986, C-44238, C-49509, C-50337, C-50936, C-58278, C-60553, C-61692, C-65846, C-66606, C-68944, C-75058, C-79835, C-80259, C-80573, D-27254, D-33576, D-36806, D-37994, D-44267, D-50307, D-50550, D-78193, D-83399, E-76047, E-78943, E-79132, F-16218, F-53153, F-62189, F-81069, G-30788, G-32607, G-50318, H-06459, H-07255, H-11407, H-18319, H-21364, H-23516, H-31527, H-32714, H-35964, H-45009, H-46338, H-56204, H-71931, I-58585, J-41121, K-36823, K-60180, L-29818, L-40461, L-40889, L-81220, N-20495

NITRILES B-14692, C-83592, G-72961, K-51057

NITRITES C-22458, C-38280, C-39719, G-04927, G-52029

NITROGEN A-18449, A-37721, A-50961, A-59257, A-71477, B-07664, B-67742, C-01349, C-09770, C-39719, C-50936, C-79032, D-52578, F-04674, F-13565, F-25636, F-81069, G-01096, G-28041, G-79848, G-84260, H-00301, H-00979, H-01664, H-04924, H-16399, H-23988, H-30368, H-83721, I-54961, L-57270, N-63463

NITROGEN DIOXIDE (NO2) A-00220, A-01125, A-09785, A-11916, A-17357, A-23361, A-23865, A-27314, A-29519, A-29532, A-29786, A-31529, A-36377, A-45145, A-47959, A-49738, A-63661, A-67806, A-76274, A-82279, B-07549, B-07552, B-12465, B-15322, B-16555, B-20436, B-36532, B-42083, B-56531, B-61741, B-64898, B-68633, B-68795, B-75204, C-00126, C-02681, C-03527, C-04458, C-05078, C-05914, C-06279, C-08077, C-09770, C-09983, C-11574, C-17128, C-20030, C-20540, C-20650, C-22517, C-22812, C-23162, C-24970, C-26121, C-26122, C-26707, C-27294, C-28126, C-29198, C-30840, C-31115, C-32534, C-35737, C-38280, C-38670, C-39719, C-40422, C-43985, C-43986, C-44238, C-48392, C-48916, C-50337, C-56572, C-58278, C-61692, C-61851, C-61993, C-65846, C-66606, C-66753, C-68944, C-79842, C-80259, C-80573, D-19966, D-23392, D-26086, D-26702, D-27254, D-30705, D-31396, D-33576, D-34008, D-36806, D-37994, D-44267, D-44799, D-50307, D-50550, D-50690, D-56792, D-60574, D-63186, D-74121, D-78193, D-83399, E-33092, E-76047, E-78943, E-79132, F-04674, F-16218, F-16370, F-32952, F-53153, F-78035, G-00165, G-16345, G-16916, G-18988, G-28139, G-41036, G-43277, G-50318, G-68583, G-74580, G-80857, G-84260, H-04544, H-05342, H-06404, H-06459, H-07255, H-11407, H-12042, H-12045, H-13474, H-14968, H-17109, H-18319, H-21364, H-25865, H-26055, H-27303, H-30473, H-31527, H-32714, H-35964, H-45009, H-45533, H-45540, H-46051, H-46262, H-46338, H-49778, H-50677, H-52102, H-52135, H-53903, H-54755, H-56204, H-56655, H-63626, H-65928, H-66714, H-67304, H-70776, H-71931, H-73510, H-75027, H-77325, H-79338, H-82520, H-84557, I-00695, I-23108, I-58585, J-32706, J-42746, J-43547, K-07605, K-08420, K-11414, K-19750, K-27010, K-31968, K-36823, K-41682, K-44310, K-47672, K-58638, K-58899, K-60180, K-60887, K-69550, K-71991, K-72145, K-80854, L-06734, L-06754, L-17188, L-24481, L-29504, L-29818, L-32173, L-33495, L-40889, L-44054, L-47380, L-76847, L-81220, N-04212, N-20040, N-20495, N-64937

NITROGEN ORGANIC COMPOUNDS A-01125, A-11916, A-32060, A-39460, A-43270, A-46925, A-71273, A-79280, B-24683, B-29403, B-41932, B-60864, B-79711, B-80950, B-81040, C-06279, C-17128, C-20030, C-32534, C-36125, C-38670, C-39136, C-39719, C-42928, C-45802, C-61103, C-65118, C-80259, C-83592, F-16218, F-68048, G-04927, G-12403, G-34398, G-41706, G-52029, G-71948, G-72961, H-00301, H-04728, K-41682, K-51057, K-72151, L-29504, L-57270

NITROGEN OXIDES A-00220, A-00375, A-01125, A-01687, A-02312, A-08882, A-09692, A-09785, A-11341, A-11590, A-11876, A-11877, A-11916, A-12470, A-12474, A-12557, A-12773, A-12889, A-15452, A-17357, A-20134, A-22875, A-23561, A-23865, A-24039, A-26329, A-27314, A-27617, A-27930, A-28282, A-29519, A-29532, A-29786, A-31315, A-31529, A-32060, A-32519, A-32702, A-32855, A-33853, A-34018, A-36045, A-36377, A-37721, A-39460, A-40344, A-40401, A-40471, A-41650, A-41877, A-42054, A-42680, A-42682, A-42685, A-43014, A-43270, A-43272, A-44490, A-45145, A-46925, A-47143, A-47410, A-47934, A-47939, A-47963, A-47965, A-48231, A-48946, A-49738, A-49924, A-50381, A-50961, A-51100, A-51102, A-59494, A-60281, A-60283, A-60827, A-60866, A-61007, A-61154, A-61570, A-63661, A-66977, A-67806, A-69309, A-69353, A-69422, A-71262, A-71477, A-72125, A-72133, A-74262, A-76274, A-77367, A-77522, A-79280, A-81169, A-81745, A-81861, A-82192, A-82279, B-02541, B-07549, B-07552, B-08344, B-09773, B-12465, B-15322, B-16555, B-19571, B-20436, B-24033, B-26911, B-27569, B-29680, B-29725, B-32190, B-32231, B-33554, B-35106, B-36405, B-36532, B-36552, B-36716, B-38504, B-41378, B-41569, B-42083, B-42172, B-42991, B-43299, B-45707, B-45757, B-45846, B-47086, B-47680, B-47731, B-49023, B-50937, B-51101, B-54799, B-56531, B-59845, B-60282, B-60849, B-61259, B-61741, B-61935, B-63474, B-64696, B-64858, B-65638, B-65640, B-67700, B-68633, B-68795, B-69131, B-71841, B-74480, B-75138, B-75204, B-75387, B-78245, B-83613, B-84391, C-00126, C-01349, C-02681, C-03119, C-03527, C-04458, C-05078, C-05586, C-05914, C-06112, C-06279, C-06338, C-06494, C-06983, C-08077, C-09770, C-09983, C-11574, C-12593, C-15171, C-17128, C-20030, C-20540, C-20650, C-22517, C-22812, C-22877, C-23162, C-23907, C-24603, C-24970, C-26121, C-26122, C-26707, C-26713, C-27248, C-27294, C-28102, C-28126, C-29198, C-30014, C-30840, C-31115, C-32476, C-32534, C-35108, C-35441, C-35737, C-35956, C-36125, C-38280, C-38670, C-39136, C-39719, C-40422, C-41719, C-41763, C-42926, C-42928, C-43979, C-43985, C-43986, C-44238, C-44253, C-44285, C-45760, C-46034, C-46303, C-47218, C-48392, C-48916, C-49509, C-49752, C-49879, C-49992, C-50337, C-50936, C-51762, C-56572, C-56681, C-58278, C-59513, C-59814, C-60419, C-60553, C-61103, C-61692, C-61851, C-61993, C-63848, C-64779, C-65118, C-65846, C-66606, C-68944, C-69152, C-69174, C-70686, C-71044, C-74221, C-74346, C-74471, C-74942, C-75058, C-79835, C-79842, C-80103, C-80259, C-80573, C-83495, C-84471, C-84660, D-17102, D-18537, D-19966, D-23392, D-25593, D-26086, D-26702, D-27254, D-28097, D-30705, D-31371, D-31396, D-33425, D-33576, D-34008, D-35764, D-36806, D-37994, D-39737, D-40896, D-43317, D-44267, D-44799, D-48850, D-49860, D-50307, D-50550, D-50690, D-56792, D-60574, D-63186, D-73286, D-74121, D-78193, D-78442, D-78954, D-83399, D-84625, E-29774, E-33092,

E-59234, E-76047, E-78943, E-79132, F-04674, F-16218, F-16370, F-32952, F-44721, F-53153, F-57580, F-57581, F-62189, F-68048, F-78035, F-81069, G-00165, G-01794, G-02539, G-03394, G-06675, G-07098, G-16345, G-16916, G-18785, G-18988, G-19148, G-24153, G-26274, G-27379, G-27895, G-28041, G-28139, G-30788, G-32607, G-33510, G-38616, G-38721, G-39494, G-41036, G-41706, G-43277, G-43323, G-43636, G-46085, G-48068, G-49756, G-50161, G-50318, G-50916, G-52029, G-55517, G-61467, G-66044, G-68583, G-71484, G-73658, G-74290, G-74580, G-78873, G-80857, G-84260, H-00301, H-00979, H-01809, H-03395, H-04544, H-05342, H-05421, H-05485, H-06404, H-06459, H-06557, H-07255, H-08884, H-11157, H-11407, H-12042, H-12045, H-13474, H-14968, H-17109, H-17710, H-18319, H-19604, H-21364, H-23295, H-23516, H-25865, H-26055, H-26158, H-27303, H-28474, H-30473, H-31527, H-32714, H-32982, H-33127, H-33468, H-33716, H-35613, H-35964, H-38574, H-40341, H-40368, H-41362, H-41983, H-45007, H-45009, H-45022, H-45130, H-45345, H-45467, H-45533, H-45540, H-45776, H-46051, H-46198, H-46262, H-46338, H-47014, H-49644, H-49778, H-49779, H-50677, H-50780, H-51526, H-51953, H-52102, H-52135, H-53903, H-54755, H-56204, H-56428, H-56655, H-59028, H-60913, H-63626, H-65928, H-66714, H-66715, H-67056, H-67304, H-67348, H-67457, H-70776, H-71931, H-73510, H-75027, H-76233, H-76451, H-76452, H-77325, H-78580, H-79338, H-79976, H-82520, H-84290, H-84557, I-00695, I-23108, I-46606, I-54961, I-58585, J-30226, J-30696, J-32706, J-41121, J-42746, J-43547, J-44672, J-67865, K-07605, K-08420, K-11414, K-14772, K-19750, K-27010, K-28466, K-31968, K-34063, K-36823, K-41682, K-44310, K-46081, K-47672, K-51229, K-58638, K-58899, K-60180, K-60887, K-68582, K-69550, K-71991, K-72145, K-72151, K-79255, K-80854, L-06734, L-06754, L-09677, L-17188, L-24122, L-24481, L-25427, L-25542, L-29504, L-29818, L-30620, L-32173, L-32245, L-32789, L-33495, L-35795, L-40461, L-40889, L-41455, L-42188, L-42873, L-42874, L-44054, L-47380, L-48719, L-50180, L-73836, L-73839, L-76397, L-76847, L-77234, L-81220, N-04212, N-20040, N-20495, N-37027, N-44066, N-46820, N-49170, N-50748, N-50867, N-63463, N-64937, N-65407, N-66750

NITROGEN TRIOXIDE (NO3) C-32534, C-66753, D-27254, H-00979

NITROGENOUS FERTILIZER PLANTS B-81040

NITROMETHANE H-01809, H-11157

NITROUS ACID C-24970, C-61103, H-18226

NITROUS ANHYDRIDE (N2O3) N-04212

NITROUS OXIDE (N2O) A-15452, B-36532, C-39719, C-50337, C-61103, C-61692, F-57580, F-57581, G-02539, G-28041, G-84260

NON-DISPERSIVE INFRARED SPECTROMETRY C-83495

NON-INDUSTRIAL EMISSION SOURCES (STATION A-00220, A-00340, A-00640, A-01687, A-02312, A-03129, A-03450, A-05090, A-08816, A-09785, A-11590, A-11876, A-12631, A-12773, A-12889, A-17357, A-17464, A-19400, A-22875, A-23561, A-26254, A-27595, A-31529, A-32139

NON-INDUSTRIAL EMISSION SOURCES (NEC) A-32139

NON-INDUSTRIAL EMISSION SOURCES (STATION A-32576, A-32702, A-32855, A-34334, A-35985

NON-INDUSTRIAL EMISSION SOURCES (NEC) A-35985

NON-INDUSTRIAL EMISSION SOURCES (STATION A-36377, A-37190

NON-INDUSTRIAL EMISSION SOURCES (NEC) A-37996

NON-INDUSTRIAL EMISSION SOURCES (STATION A-37996, A-39460

NON-INDUSTRIAL EMISSION SOURCES (NEC) A-39587

NON-INDUSTRIAL EMISSION SOURCES (STATION A-39587, A-39862

NON-INDUSTRIAL EMISSION SOURCES (NEC) A-40182

NON-INDUSTRIAL EMISSION SOURCES (STATION A-40182, A-40401, A-40471, A-40600, A-42675, A-43403, A-46925, A-47048, A-47143, A-47188, A-47954, A-47959, A-48048

NON-INDUSTRIAL EMISSION SOURCES (NEC) A-48048

NON-INDUSTRIAL EMISSION SOURCES (STATION A-48231, A-48849, A-49738, A-49924, A-50242, A-50381, A-50938, A-50961, A-51100, A-51102, A-51137, A-55922, A-59494, A-68912

NON-INDUSTRIAL EMISSION SOURCES (NEC) A-74154, A-74262

NON-INDUSTRIAL EMISSION SOURCES (STATION A-79567

NON-INDUSTRIAL EMISSION SOURCES (NEC) A-80334

NON-INDUSTRIAL EMISSION SOURCES (STATION A-82944

NON-INDUSTRIAL EMISSION SOURCES (NEC) A-83543

NON-INDUSTRIAL EMISSION SOURCES (STATION B-02541, B-06587, B-08344, B-09664, B-18144, B-24117, B-24683

NON-INDUSTRIAL EMISSION SOURCES (NEC) B-24683

NON-INDUSTRIAL EMISSION SOURCES (STATION B-25038

NON-INDUSTRIAL EMISSION SOURCES (NEC) B-25038

NON-INDUSTRIAL EMISSION SOURCES (STATION B-25638, B-26911

NON-INDUSTRIAL EMISSION SOURCES (NEC) B-28320

NON-INDUSTRIAL EMISSION SOURCES (STATION B-28320

NON-INDUSTRIAL EMISSION SOURCES (NEC) B-28502

NON-INDUSTRIAL EMISSION SOURCES (STATION B-28502, B-32231, B-32232

NON-INDUSTRIAL EMISSION SOURCES (NEC) B-32232

NON-INDUSTRIAL EMISSION SOURCES (STATION B-35111, B-36716, B-40251

NON-INDUSTRIAL EMISSION SOURCES (NEC) B-40251, B-41569

NON-INDUSTRIAL EMISSION SOURCES (STATION B-41569, B-42287, B-43840

NON-INDUSTRIAL EMISSION SOURCES (NEC) B-43840

NON-INDUSTRIAL EMISSION SOURCES (STATION B-44716

NON-INDUSTRIAL EMISSION SOURCES (NEC) B-47677

NON-INDUSTRIAL EMISSION SOURCES (STATION B-47677

NON-INDUSTRIAL EMISSION SOURCES (NEC) B-47680

NON-INDUSTRIAL EMISSION SOURCES (STATION B-47680, B-47731

NON-INDUSTRIAL EMISSION SOURCES (NEC) B-47731

NON-INDUSTRIAL EMISSION SOURCES (STATION B-47821

NON-INDUSTRIAL EMISSION SOURCES (NEC) B-47821

NON-INDUSTRIAL EMISSION SOURCES (STATION B-49023

NON-INDUSTRIAL EMISSION SOURCES (NEC) B-49023

NON-INDUSTRIAL EMISSION SOURCES (STATION B-49031

NON-INDUSTRIAL EMISSION SOURCES (NEC) B-49031

NON-INDUSTRIAL EMISSION SOURCES (STATION B-49929, B-50154, B-50937, B-51101, B-51845

NON-INDUSTRIAL EMISSION SOURCES (NEC) B-51845

NON-INDUSTRIAL EMISSION SOURCES (STATION B-55180, B-56057

NON-INDUSTRIAL EMISSION SOURCES (NEC) B-56057

NON-INDUSTRIAL EMISSION SOURCES (STATION B-58879, B-59845

NON-INDUSTRIAL EMISSION SOURCES (NEC) B-79657

NON-INDUSTRIAL EMISSION SOURCES (STATION C-06279, C-06494, C-07719, C-23518

NON-INDUSTRIAL EMISSION SOURCES (NEC) C-23518

NON-INDUSTRIAL EMISSION SOURCES (STATION C-23683, C-35956, C-36002

NON-INDUSTRIAL EMISSION SOURCES (NEC) C-36002, C-38280

NON-INDUSTRIAL EMISSION SOURCES (STATION C-38670

NON-INDUSTRIAL EMISSION SOURCES (NEC) C-38670, C-44710

NON-INDUSTRIAL EMISSION SOURCES (STATION C-44710, C-47193

NON-INDUSTRIAL EMISSION SOURCES (NEC) C-47193

NON-INDUSTRIAL EMISSION SOURCES (STATION C-50936

NON-INDUSTRIAL EMISSION SOURCES (NEC) C-50936

NON-INDUSTRIAL EMISSION SOURCES (STATION C-58278

NON-INDUSTRIAL EMISSION SOURCES (NEC) C-58278

NON-INDUSTRIAL EMISSION SOURCES (STATION D-09590, D-23862, D-25593, D-26086, D-26702

NON-INDUSTRIAL EMISSION SOURCES (NEC) D-30058

NON-INDUSTRIAL EMISSION SOURCES (STATION D-30058, D-31371

NON-INDUSTRIAL EMISSION SOURCES (NEC) D-31371

NON-INDUSTRIAL EMISSION SOURCES (STATION D-33108
NON-INDUSTRIAL EMISSION SOURCES (NEC) D-33108
NON-INDUSTRIAL EMISSION SOURCES (STATION D-33309, D-34008, D-35764, D-37502, D-37994, D-41979
NON-INDUSTRIAL EMISSION SOURCES (NEC) D-41979, D-44267
NON-INDUSTRIAL EMISSION SOURCES (STATION D-44267, D-49860, D-56465
NON-INDUSTRIAL EMISSION SOURCES (NEC) D-56465
NON-INDUSTRIAL EMISSION SOURCES (STATION D-56792, D-66083, E-02325, E-40271
NON-INDUSTRIAL EMISSION SOURCES (NEC) E-77970
NON-INDUSTRIAL EMISSION SOURCES (STATION E-77970, F-04468, F-20932, G-01047, G-01096, G-01794, G-05833, G-06497, G-07098, G-10842, G-11000, G-12403, G-30788, G-31234, G-31319
NON-INDUSTRIAL EMISSION SOURCES (NEC) G-32152
NON-INDUSTRIAL EMISSION SOURCES (STATION G-32152, G-32601
NON-INDUSTRIAL EMISSION SOURCES (NEC) G-32601
NON-INDUSTRIAL EMISSION SOURCES (STATION G-38721, G-39494
NON-INDUSTRIAL EMISSION SOURCES (NEC) G-39494
NON-INDUSTRIAL EMISSION SOURCES (STATION G-43323
NON-INDUSTRIAL EMISSION SOURCES (NEC) G-43323, G-46085
NON-INDUSTRIAL EMISSION SOURCES (STATION G-46085
NON-INDUSTRIAL EMISSION SOURCES (NEC) G-52557
NON-INDUSTRIAL EMISSION SOURCES (STATION G-52557, H-00137, H-00301, H-01398, H-08884, H-09553, H-16617, H-21062, H-21189, H-22092, H-23624, H-23661, H-23988, H-24282, H-24366, H-25366, H-25499
NON-INDUSTRIAL EMISSION SOURCES (NEC) H-32291
NON-INDUSTRIAL EMISSION SOURCES (STATION H-32291, H-32536, H-32539
NON-INDUSTRIAL EMISSION SOURCES (NEC) H-32673
NON-INDUSTRIAL EMISSION SOURCES (STATION H-32673
NON-INDUSTRIAL EMISSION SOURCES (NEC) H-32736
NON-INDUSTRIAL EMISSION SOURCES (STATION H-32736
NON-INDUSTRIAL EMISSION SOURCES (NEC) H-33290
NON-INDUSTRIAL EMISSION SOURCES (STATION H-33290, H-33606, H-35992
NON-INDUSTRIAL EMISSION SOURCES (NEC) H-35992
NON-INDUSTRIAL EMISSION SOURCES (STATION H-36998, H-37403
NON-INDUSTRIAL EMISSION SOURCES (NEC) H-37403, H-37567
NON-INDUSTRIAL EMISSION SOURCES (STATION H-37567, H-37792, H-38568, H-39190
NON-INDUSTRIAL EMISSION SOURCES (NEC) H-39923
NON-INDUSTRIAL EMISSION SOURCES (STATION H-39923, H-40460, H-43226, H-46051, H-50415, H-57859
NON-INDUSTRIAL EMISSION SOURCES (NEC) H-71098
NON-INDUSTRIAL EMISSION SOURCES (STATION I-07553, I-23108
NON-INDUSTRIAL EMISSION SOURCES (NEC) I-23108, I-39031
NON-INDUSTRIAL EMISSION SOURCES (STATION I-39031, I-56143, J-30696, K-10168, K-37472
NON-INDUSTRIAL EMISSION SOURCES (NEC) K-37472, K-74109
NON-INDUSTRIAL EMISSION SOURCES (STATION L-09677, L-19434, L-25427, L-27677
NON-INDUSTRIAL EMISSION SOURCES (NEC) L-27677, L-28349
NON-INDUSTRIAL EMISSION SOURCES (STATION L-28349
NON-INDUSTRIAL EMISSION SOURCES (NEC) L-29421
NON-INDUSTRIAL EMISSION SOURCES (STATION L-29421, L-32173, L-32245, L-32272, L-32354, L-32884, L-37747, L-37943
NON-INDUSTRIAL EMISSION SOURCES (NEC) L-43007, L-48788
NON-INDUSTRIAL EMISSION SOURCES (STATION L-48788
NON-INDUSTRIAL EMISSION SOURCES (NEC) L-73836, L-77234
NON-INDUSTRIAL EMISSION SOURCES (STATION L-80894, N-04212, N-12307, N-16400, N-21287, N-32254, N-46820
NON-INDUSTRIAL EMISSION SOURCES (NEC) N-63463
NON-METHANE HYDROCARBONS N-66750
NON-METROPOLITAN AREAS A-11453, A-22973, B-26911, C-11915, C-12334, C-18344, C-44174, C-60410, D-17986, D-19966, D-24736, D-31396, D-33080, D-34008, D-37607, D-50307, D-52811, D-55187, G-14477, G-19215, G-19880, G-23763, G-26846, G-28754, G-30183, G-38942, G-56931, G-68520, G-84266, H-00737, H-10711, H-17163, H-19604, H-20157, H-20573, H-20707, H-20708, H-24282, H-25795, H-27030, H-30142, H-32672, H-36994, H-37567, H-40599, H-42601, H-43226, H-50959, H-51754, H-55066, H-60760, H-65103, H-66983, H-68394, H-70279, H-73518, H-74588, H-80064, I-54961, J-32706, J-60298, J-67865, K-69550, L-06349, L-24010, L-25642, L-33495, N-12307, N-16400
NORTH CAROLINA H-52651
NORWAY A-40886, A-55407, B-49477, B-52179, B-71297, C-44083, C-49476, C-52206, G-84233, H-38412, H-52705, H-80189, J-48171, L-38573, L-44598, L-46586
NOSE C-36771, G-06288, G-10203, G-23003, G-33509, G-33511, G-41684, G-83177
NOX CONTROL B-81256
NUCLEAR POWER A-59921, B-24683, C-57079, E-59234
NUCLEAR POWER PLANTS A-17464, A-17883, A-32139, A-47410, A-47966, A-81931, B-12127, B-24683, B-26911, D-56464, F-13998, H-23624, L-19434, L-57270
NUCLEAR REACTIONS E-40271
NUCLEATION A-08882, A-32060, B-29114, H-46338
NUCLEIC ACIDS H-04728, H-06413, H-06681, H-13247, H-16900, H-21498, H-25618
NYLON B-59230, D-09590, I-07553, I-40510

O

OAK TREES H-80067, H-80493
OATS B-02541, G-01728, H-00654, H-01800, H-05744, H-11466, H-16222, H-22624, H-32854, H-45776, H-71931, H-81495, K-07605
OCEANS A-37996, A-83543, D-09658, D-33017, D-62438, E-30126, E-43424, F-44721, G-67325, H-16150, H-28149
ODOR CONTROL A-32855, A-48231, A-54622, B-14692, B-26908, B-26911, B-35111, B-45707, B-51845, B-60864, L-39306
ODOR COUNTERACTION A-32855, A-48231, A-54622, B-14692, B-26908, B-26911, B-35111, B-45707, B-51845, B-60864, L-39306
ODORIMETRY A-32855, C-35956, C-36771, C-49879, C-66753, D-31371, G-33509, K-31968
ODOROUS POLLUTANTS A-32060, A-40344, A-79280, F-52013, L-80894
ODORS A-01528, A-02312, A-02988, A-09785, A-09799, A-11916, A-17344, A-17464, A-17471, A-26254, A-27314, A-27930, A-30447, A-30517, A-31283, A-31935, A-39460, A-40180, A-40182, A-41650, A-42683, A-42751, A-45858, A-49924, A-53955, A-55212, A-55407, A-58939, A-59775, A-60728, A-60827, A-66977, A-71477, A-81169, B-04368, B-07815, B-10372, B-21795, B-28786, B-32627, B-32712, B-36532, B-37603, B-40414, B-45078, B-47125, B-47256, B-48811, B-48814, B-49023, B-50435, B-51755, B-52094, B-52838, B-52852, B-53603, B-53620, B-54310, B-55524, B-56057, B-59459, B-60206, B-61273, B-66592, B-70428, B-70658, B-70659, B-81645, C-13056, C-29220, C-40409, C-43570, C-66753, D-06809, D-25093, D-33108, D-33858, D-39737, D-48791, D-49860, D-53889, D-56464, D-66083, E-49433, E-59075, G-04145, G-07098, G-11467, G-12547, G-12550, G-15040, G-15555, G-25469, G-28139, G-29415, G-30183, G-32607, G-38106, G-40527, G-44362, G-44597, G-47906, G-49271, G-50371, G-50414, G-56931, G-56933, G-62177, G-62596, G-64484, H-08884, H-10342, H-11650, H-12529, H-12538, H-12552, H-12553, H-12554, H-18270, H-18272, H-21422, H-27030, H-29277, H-32282, H-32291, H-32339, H-44428, H-46217, H-46719, H-49561, H-50415, H-50959, H-52829, H-52994, H-53025, H-58777, H-58941, H-60690, H-61000, H-65715, I-23108, I-39031, J-29923, J-30696, J-39910, J-48171, K-10168, K-51212, K-58899, L-06754, L-24010, L-37747, L-40461, N-66750
OHIO D-09590, D-23845, D-24736, D-39737, D-52578, D-56463, D-63526, G-28199, L-09677, L-44598

OIL BURNERS A-45858, B-38476
OKLAHOMA G-44590, K-37472
OLEFINS A-03129, A-09785, A-18449, A-39460, A-44566, A-48572, B-02541, B-26911, B-28502, B-59230, B-62165, C-17128, C-27769, C-38670, C-39719, C-50337, C-67116, E-29774, E-43855, E-76047, F-02337, F-03062, F-25636, F-59528, G-26274, G-28041, G-45583, G-48068, G-72961, G-79848, G-84260, H-00737, H-01809, H-02537, H-03395, H-03472, H-03611, H-03612, H-03613, H-03616, H-03629, H-03766, H-04544, H-04984, H-05342, H-05421, H-05485, H-05724, H-08884, H-11100, H-12042, H-12045, H-12155, H-13474, H-17710, H-17749, H-17779, H-20157, H-20158, H-21364, H-22789, H-25865, H-26055, H-26158, H-26861, H-30473, H-33127, H-40202, H-41699, H-41983, H-42923, H-45130, H-45214, H-45540, H-46262, H-46338, H-48413, H-49779, H-50780, H-52102, H-52409, H-52698, H-52928, H-54755, H-56655, H-60907, H-65928, H-67026, H-67056, H-67304, H-67348, H-67457, H-70984, H-78580, H-84651, J-32706, J-55161, K-03582, K-07605, K-47672, K-51057, K-71991, L-44054, N-63463
OLFACTION C-66753
ONIONS H-84553
OPEN BURNING A-01687, A-40344, A-47143, B-26911, B-44979, C-23683, C-35956, D-09590, D-26702, H-01398, H-21189, L-32173, L-32245, L-32272, N-12307
OPEN HEARTH FURNACES A-00375, A-01528, A-26254, A-41877, A-42682, A-45858, A-47962, A-49617, A-60866, B-05567, B-06587, B-23182, B-25433, B-29680, B-32627, D-39737, L-09677, L-38573
OPERATING COSTS B-77475, J-76213
OPERATING CRITERIA A-02847, A-03565, A-05040, A-05139, A-05140, A-05587, A-08102, A-08116, A-08748, A-09651, A-09690, A-09692, A-09693, A-09694, A-09695, A-09696, A-09697, A-11341, A-11590, A-11876, A-11877, A-12470, A-12474, A-12587, A-12676, A-12692, A-12740, A-12741, A-12747, A-12750, A-12809, A-12813, A-12822, A-12828, A-12884, A-12886, A-12898, A-12889, A-12919, A-12929, A-12931, A-12933, A-41877, A-44490, A-59921, A-67748, A-67834, A-75206, A-76152, A-76190, A-81861, B-25638, C-48492, C-49509, C-49992, G-71324, K-71991, L-09677, L-32884, L-33722, L-59722, L-77817
OPERATING VARIABLES A-05871, A-18656, A-21380, A-33853, A-35985, A-37752, A-39635, A-40180, A-40344, A-42751, A-43014, A-48429, A-61007, A-61183, A-61800, A-67834, A-68823, A-75089, A-75206, A-76152, A-76190, A-77993, B-10618, B-18830, B-20857, B-22484, B-26279, B-26317, B-26745, B-26911, B-28034, B-31567, B-31889, B-33554, B-35448, B-37544, B-38188, B-38874, B-40712, B-40892, B-43533, B-45380, B-45544, B-45757, B-47186, B-47463, B-47466, B-47677, B-48480, B-48814, B-49420, B-49929, B-51101, B-52852, B-53603, B-72656, B-75387, B-76008, B-76232, C-20030, C-21806, C-23654, C-24022, C-24050, C-24399, C-26729, C-35956, C-37515, C-38741, C-41064, C-41491, C-43979, C-43985, C-43986, C-48674, C-50337, C-51599, C-52629, C-74234, C-82650, D-24801, F-39861, G-27895, H-20157, K-51212
OPINION SURVEYS M-68522
OPTICAL METHODS B-13771, C-00264, C-23657, C-23907, C-43234, C-79835, F-15927, G-01047, G-04145, H-00265, H-01664, H-07047, H-18226, H-22284, H-56625, I-00695, I-08076
ORANGES H-82146
ORCHARDS A-02312, E-70747, G-01674, H-00187, H-00265, H-00301, H-10342, H-15604, H-16385, H-24024, H-28446, H-28476, H-32339, H-32539, H-32771, H-39537, H-42958, H-44345, H-53370, H-60907, H-73518, L-32173, L-32245, L-32272
OREGON A-05601, H-00301, H-22084, H-22092, H-26718, L-09677, L-44598, L-66700
ORGANIC ACIDS A-02312, A-09785, A-22875, A-30517, A-31529, A-32855, A-34018, A-36377, A-37190, A-42680, A-43270, A-48116, A-48572, A-50938, A-51100, A-71262, B-26745, B-38504, B-45846, B-49023, B-52852, B-60864, B-73031, B-79711, C-00264, C-03478, C-17128, C-20701, C-21881, C-24018, C-24331, C-25441, C-26122, C-26485, C-29771, C-32476, C-35737, C-35956, C-36125, C-39719, C-42928, C-43985, C-43986, C-44253, C-46303, C-59513, C-67116, D-31371, D-35764, F-28428, G-01338, G-10362, G-26274, G-41036, G-48068, G-71536, G-71948, G-80197, G-84260, H-04728, H-05398, H-10150, H-12032, H-28427, H-28474, H-36742, H-40202, H-42907, H-52928, H-59198, H-67457, I-23108, I-40510, I-65935, K-41682, L-17188, L-29504, L-82278
ORGANIC DISEASES G-48068
ORGANIC WASTES A-71262, C-36002, H-40460, K-78880, L-37747
ORGANOMETALLICS A-37721, A-75077, C-04463, C-24310, C-45802, C-61692, C-61957
ORSAT ANALYSIS A-09651, A-09696, A-09697, A-12587, A-12773, A-12889, C-35956, C-46034, C-59513
OSAKA D-61140, K-74109
OVERFIRE AIR B-59230
OXIDANTS A-00220, A-02312, A-08882, A-09735, A-34018, A-36377, A-39460, A-71273, A-76274, B-29680, C-01349, C-03527, C-04405, C-05892, C-24118, C-25223, C-27248, C-27294, C-28102, C-30840, C-32476, C-32534, C-39022, C-41763, C-42926, C-43985, C-43986, C-46034, C-47218, C-48916, C-51762, C-58278, C-61692, C-61851, C-61993, C-65118, C-65846, C-66606, C-66753, C-67116, C-69174, C-74346, C-74471, C-83495, C-84660, D-09590, D-26086, D-26702, D-28097, D-33425, D-33576, D-34008, D-48850, D-49860, D-50307, D-56792, D-73835, D-78954, D-84625, E-04987, E-05054, F-55415, G-03394, G-05833, G-27379, G-38616, G-43636, G-49756, G-61467, G-73658, G-74580, G-80857, H-01250, H-01398, H-01800, H-01809, H-02379, H-02537, H-03395, H-03611, H-03612, H-03613, H-03616, H-05342, H-05560, H-06459, H-08884, H-11157, H-11407, H-16617, H-17779, H-21093, H-22789, H-23516, H-26158, H-26861, H-27303, H-33716, H-35964, H-41189, H-41699, H-42923, H-45130, H-45533, H-46262, H-49778, H-49779, H-51321, H-51526, H-53903, H-54297, H-56885, H-61834, H-65928, H-67056, H-67304, H-69800, H-73518, H-74624, H-76233, H-76452, H-76715, H-78580, H-79976, I-00695, I-54961, I-58585, J-44672, J-55161, J-60298, J-67865, K-07605, K-08420, K-14772, K-19750, K-27010, K-31968, K-37472, K-47672, K-51212, K-51229, K-58899, K-66916, K-69550, K-72145, K-80854, L-06349, L-06734, L-33495, L-42188, L-42874, L-47380, L-50180, L-73839, L-76847, N-12307, N-44066, N-50748, N-66750
OXIDATION A-00640, A-08486, A-44566, B-49031, C-00126, C-09770, C-80573, E-33579, G-04145, G-08030, H-06459, H-07046, H-07047, H-07255
OXYGEN A-09214, A-09321, A-09332, A-09697, A-11541, A-11590, A-12587, A-12773, A-12889, A-22875, A-65064, B-29630, B-42172, B-79711, C-22458, C-24008, C-27341, C-39719, C-60553, C-66753, C-80259, D-52578, E-05054, E-29774, E-33579, F-13565, F-39861, F-78035, G-01047, G-18785, G-23711, G-24153, G-79848, G-84236, H-03570, H-03571, H-03572, H-06459, H-11100, H-27303, H-35964, H-69966, I-07553, N-66750
OXYGEN CONSUMPTION D-31371, H-03570, H-03571, H-17970
OXYGEN LANCING B-07664, J-29923
OZONE A-00375, A-08882, A-09785, A-12557, A-15452, A-23561, A-24039, A-27314, A-27930, A-36045, A-39460, A-47143, A-60827, A-71262, A-71477, A-81169, A-82279, B-02541, B-04853, B-19571, B-84391, C-00126, C-01349, C-02681, C-05892, C-06112, C-06352, C-06983, C-15171, C-20030, C-20540, C-20595, C-22812, C-23683, C-23907, C-24118, C-24603, C-25223, C-26122, C-27044, C-27248, C-28126, C-29198, C-29771, C-30840, C-32476, C-35441, C-39022, C-39719, C-42926, C-42928, C-43672, C-43979, C-43981, C-43986, C-44285, C-48916, C-49879, C-50337, C-56681, C-61692, C-65118, C-65846, C-66606, C-66753, C-67116, C-68944, C-70686, C-79842, C-80103, C-80259, C-84660, D-09590, D-32679, D-33425, D-34008, D-56792, E-29774, E-33579, E-72995, E-76047, E-79132, F-78035, G-00165, G-01728, G-01794, G-02539, G-03394, G-05833, G-07098, G-16916, G-19148, G-27379, G-30788, G-34398, G-43277, G-43323, G-49756, G-68583, G-73658, G-79848, G-84260, H-00654, H-00737, H-01398, H-01800, H-01809, H-02379, H-02537, H-03395, H-03611, H-03613, H-03616, H-03629, H-03766, H-04544, H-05342, H-05421, H-05485, H-05724, H-06459, H-06557, H-07255, H-08884, H-11157, H-11407, H-12042, H-12045, H-12155, H-13474, H-14968, H-16894, H-17749, H-17779, H-18507, H-19656, H-19713, H-20157, H-21364, H-22789, H-23295, H-23516, H-24533, H-25769, H-25865, H-26055, H-26861, H-27303, H-28437, H-28475, H-30473, H-31527, H-32714, H-33127, H-33468, H-35877, H-40341, H-41189, H-41699,

H-41983, H-43622, H-44411, H-45009, H-45214, H-45345, H-45533, H-45540, H-45557, H-45776, H-46198, H-46262, H-46338, H-48639, H-49644, H-49647, H-49778, H-49779, H-50157, H-50677, H-50780, H-51321, H-51526, H-52102, H-52135, H-52409, H-52698, H-52928, H-53903, H-54755, H-56204, H-56655, H-57810, H-59028, H-62275, H-63626, H-65928, H-66714, H-67026, H-67056, H-67304, H-67348, H-67457, H-68575, H-68602, H-70776, H-70984, H-71931, H-72762, H-73510, H-76233, H-76451, H-76452, H-76715, H-77325, H-77329, H-78580, H-79338, H-80575, H-82520, H-84557, H-84651, I-00695, I-07553, I-27060, I-46606, I-58585, J-32706, J-43002, J-43547, J-44672, K-07605, K-11414, K-36823, K-51057, K-58638, K-60180, K-71991, L-25542, L-29818, L-32145, L-33495, L-40889, L-44054, L-47380, L-50180, N-04212, N-20040, N-44066, N-49170, N-66750

P

PACKED TOWERS A-03090, A-09332, A-09799, B-06587, B-06344, B-22040, B-22484, B-24033, B-24110, B-24355, B-26317, B-26745, B-28320, B-28783, B-30276, B-31889, B-32461, B-35448, B-36532, B-37914, B-38504, B-42287, B-43299, B-45078, B-47054, B-47086, B-48879, B-49420, B-49929, B-52838, B-52852, B-60075, B-80356, G-40527, L-24481, L-33722

PAINTS G-18988, I-07553, I-24308, I-27060, I-40833

PAINTS AND ALLIED PRODUCTION A-40344, A-45858, A-47963

PAPER B-61954

PAPER AND ALLIED MANUFACTURING A-03129, A-20134, A-26254, A-30517, A-36377, A-39460, A-40159, A-40344, A-45858, A-46558, A-47963, B-33918, B-44979, B-45544, B-45707, B-47731, C-35956, D-09658, D-33108, D-70500, G-74369, H-39537, J-48171, K-51212, L-20273, L-29421, L-37747, L-47380

PAPER CHROMATOGRAPHY C-01313, C-39288, H-12032, H-21498, I-07553, I-24308, I-27060

PAPER MILLS A-03129, A-20134, A-30517, A-39460, A-40159, A-45858, A-47963, B-33918, B-45707, C-35956, D-70500, G-74369, H-39537, J-48171, L-29421, L-37747, L-47380

PARIS A-11453, G-30788, N-64545

PARTICLE COUNTING C-22877, C-43234, C-47218, C-48916, C-52206, C-61957

PARTICLE GROWTH A-09799, A-28038, B-33971, B-38188, B-47341, B-71841, F-15927

PARTICLE INVESTIGATION METHODS A-11877, A-31529, A-33853, A-40471, A-42731, A-43816, B-22913, B-22943, B-26745, B-29680, B-37914, B-47466, C-00126, C-00626, C-00636, C-00941, C-01313, C-01593, C-02042, C-02681, C-03550, C-04038, C-05439, C-06962, C-07710, C-07871, C-11404, C-11574, C-11779, C-12334, C-22517, C-22812, C-22877, C-23096, C-23657, C-24603, C-25180, C-25487, C-26707, C-28285, C-28738, C-29426, C-29771, C-30300, C-30432, C-30958, C-32476, C-32534, C-34125, C-34126, C-35956, C-37579, C-39022, C-39719, C-40409, C-41624, C-42926, C-43234, C-43979, C-43985, C-43986, C-44083, C-44238, C-44881, C-47218, C-48674, C-48916, C-49992, C-52206, C-56244, C-60951, C-61957, C-64090, C-68086, C-71244, C-71245, C-74234, C-76212, C-82273, D-19966, D-28771, D-30058, D-33858, D-39182, D-52578, D-58427, D-66083, E-04987, F-34948, G-06485, G-08031, H-00631, H-18319, H-24362, H-30142, K-08420, L-24481, N-64545

PARTICLE SEPARATION A-11877, A-31529, A-40471, A-43816, B-22913, B-22943, B-26745, B-29680, B-37914, C-00126, C-00626, C-00636, C-00941, C-01313, C-01593, C-02042, C-02681, C-03550, C-04038, C-05439, C-06962, C-07710, C-07871, C-11404, C-11574, C-11779, C-12334, C-22517, C-22812, C-22877, C-23096, C-23657, C-24603, C-25180, C-25487, C-26707, C-28285, C-28738, C-29426, C-29771, C-30300, C-30432, C-30958, C-32476, C-34125, C-34126, C-35956, C-37579, C-39022, C-40409, C-41624, C-42926, C-43986, C-44083, C-44238, C-44881, C-47218, C-48674, C-48916, C-49992, C-56244, C-60951, C-61957, C-64090, C-68086, C-71244, C-71245, C-74234, C-76212, C-82273, D-19966, D-28771, D-30058, D-33858, D-39182, D-52578, D-58427, D-66083, F-34948, G-06485, G-08031, H-00631, H-18319, H-24362, H-30142, L-24481, N-64545

PARTICLE SHAPE A-27617, G-04145

PARTICLE SIZE A-06371, A-09799, A-22875, A-23561, A-27617, A-32702, A-42731, A-44566, A-44605, A-47954, A-64926, A-76122, B-07552, B-13771, B-22943, B-24110, B-27282, B-29403, B-32627, B-33971, B-38439, B-46050, B-59459, B-77838, B-78245, B-81645, C-03527, C-07871, C-22517, C-23096, C-27248, C-30300, C-30432, C-35956, C-43234, C-44881, C-52206, C-69152, C-81357, C-81439, D-21419, D-28771, D-58218, D-71348, F-15927, G-04734, G-11000, G-28199, G-28429, K-31968, N-04212, N-17260, N-46820

PARTICLE SIZE DISTRIBUTION A-76152, A-82353

PARTICULATE CLASSIFICATION METHODS A-01528, A-02312, A-03129, A-06371, A-09785, A-09799, A-11876, A-20134, A-22875, A-22973, A-23561, A-26254, A-27617, A-30218, A-32702, A-32855, A-34018, A-37190, A-37562, A-37996, A-40180, A-41650, A-41877, A-42680, A-42731, A-42751, A-44490, A-44566, A-44605, A-47143, A-47954, A-48231, A-48946, A-52508, A-54622, A-66977, A-67940, A-71262, A-71273, B-07552, B-13771, B-14692, B-22943, B-24110, B-25638, B-26908, B-26911, B-27282, B-29403, B-32627, B-33971, B-38439, B-42104, B-45544, B-46050, B-47680, B-51845, B-59459, C-03527, C-06112, C-07871, C-16109, C-22517, C-23096, C-27248, C-30014, C-30300, C-30432, C-35956, C-36771, C-41719, C-42928, C-43234, C-44881, C-46034, C-48492, C-49879, C-52206, C-52992, C-59814, C-61692, C-69152, C-69174, C-74346, D-09590, D-23845, D-28771, D-31371, D-33108, D-35764, D-41979, D-49860, D-56792, D-58218, D-78442, F-15927, G-04145, G-04734, G-11000, G-12282, G-28199, G-28429, G-33509, G-33511, G-41224, G-41688, G-49223, H-19656, H-43226, H-70776, J-41121, J-42746, J-48171, K-03582, K-31968, K-37472, K-66916, K-72151, L-06349, L-09677, L-17188, L-24122, L-27677, L-32354, L-37747, L-37943, L-39306, L-42810, L-42873, L-42874, L-50180, L-52026, L-61705, L-73836, N-04212, N-16400, N-17260, N-20495, N-32254, N-46820

PARTICULATE SAMPLING A-02312, A-03565, A-06371, A-08748, A-09695, A-11341, A-11590, A-11876, A-11877, A-12470, A-12474, A-12587, A-12676, A-12692, A-12740, A-12773, A-12889, A-65064, B-41418, C-03119, C-03527, C-03550, C-04038, C-05317, C-06112, C-07871, C-11574, C-11779, C-22877, C-23546, C-23657, C-27044, C-28738, C-29738, C-30958, C-33711, C-35956, C-38741, C-39288, C-40409, C-42926, C-43234, C-44083, C-44552, C-48674, C-49476, C-49752, C-50876, C-55125, C-59049, C-60278, C-60951, C-61957, C-68086, C-70686, C-71244, C-71245, C-72015, C-74234, C-76212, C-81439, C-82552, C-84214, D-09590, D-32679, D-33017, D-43317, D-58218, D-66083, E-04987, G-06485, H-20708, K-08420, L-24481

PASSIVE SMOKING N-66750

PATHOLOGICAL INCINERATORS K-78880

PATHOLOGICAL TECHNIQUES F-07714, G-01047, G-01426, G-04849, G-07917, G-08031, G-11000, G-12555, G-18809, G-27895, G-30788, G-30841, G-32601, G-32605, G-33511, G-33561, G-36751, G-39799, G-39813, G-39924, G-39931, G-40635, G-41224, G-56538, G-57024, G-59073, H-01092, H-03860, H-04917, H-04918, H-05004, H-06681, H-07047, H-08884, H-12540, H-12554, H-20690, H-25945, H-26734, H-39627, H-40341, H-49434, H-56625, H-76901

PEARS H-82435, H-83849

PEAS H-81495

PENELEC PROCESS A-43014, A-60728, B-18826, B-26908, B-69965, C-61103

PENNSYLVANIA A-00375, A-32060, D-24736, D-52578, G-18785, G-24580, G-28199, G-30788, H-00301, K-08420, K-19750, L-06734, L-09677, L-17614, L-44598, N-04212, N-28923

PENTANES C-06494

PEPPERS H-81495

PERCHLORIC ACID C-24114, C-44177, G-26873

PERFORMANCE STANDARDS A-01687, A-03129, A-29519, A-34096, A-36377, A-37190, A-38657, A-41650, A-42683, A-47963, A-68823, A-70069, A-70727, B-19212, B-25638, B-40414, B-47054, B-49031, B-53875, B-55678, B-56057, B-65640, B-78814, B-81256, C-35108, C-36800, C-41719, D-25593, D-28188, D-41979, D-42760, G-44597, G-47807, G-71484, G-71617, H-44295, H-69162, J-30696, K-14772, K-33107, K-34063, K-36823, K-37472, K-38197, K-42039,

K-44310, K-44377, K-46081, K-47672, K-51212, K-51229, K-58899, K-60180, K-66860, K-66916, K-68582, K-71991, K-72151, K-74109, K-78880, K-79255, K-80854, K-81864, K-84395, L-06938, L-06939, L-09677, L-19064, L-19434, L-20273, L-28349, L-29421, L-31492, L-32173, L-32245, L-32272, L-32884, L-33722, L-35795, L-37747, L-38669, L-39306, L-42021, L-42188, L-42873, L-44054, L-46586, L-47380, L-48719, L-48788, L-50180, L-66700, L-73839, L-77817, L-81399, N-50748, N-64545

PERMEABILITY B-26745, C-11691, G-80197, H-19949, H-45022

PERMITS L-32173, L-32245, L-32272, L-37747, L-38669, L-40461, L-67888

PEROXIDES A-11453, C-04692, C-24310, C-24359, C-42928, C-67116, G-68583, H-04544, I-46606

PEROXYACETYL NITRATE A-12557, A-23561, B-84391, C-05892, C-50337, C-67116, D-09590, D-33425, E-76047, G-01728, G-26274, G-43277, G-61146, H-00654, H-02537, H-03472, H-05342, H-05485, H-12042, H-12045, H-13474, H-14968, H-19656, H-19713, H-20157, H-21364, H-25865, H-26055, H-27303, H-28437, H-28474, H-28475, H-30473, H-31527, H-32714, H-33127, H-41699, H-41983, H-44411, H-45214, H-45533, H-45540, H-45557, H-46262, H-48639, H-50780, H-51321, H-51526, H-52102, H-52135, H-52409, H-52928, H-53903, H-54755, H-63626, H-66714, H-67026, H-67056, H-67304, H-67348, H-67457, H-68575, H-68602, H-70776, H-72762, H-76451, H-76452, H-84557, J-32706, J-43002, J-44672, N-66718, N-66750

PEROXYACYL NITRATES A-00375, A-12557, A-23561, A-47143, B-84391, C-00126, C-05892, C-35441, C-50337, C-66753, C-67116, D-09590, D-33425, E-76047, G-01728, G-26274, G-43277, G-61146, H-00654, H-00737, H-01800, H-01809, H-02537, H-03472, H-05342, H-05485, H-07255, H-11157, H-12042, H-12045, H-12155, H-13474, H-14968, H-17749, H-19656, H-19713, H-20157, H-21364, H-23516, H-25865, H-26055, H-27303, H-28437, H-28474, H-28475, H-30473, H-31527, H-32714, H-33127, H-33468, H-41699, H-41983, H-44411, H-45214, H-45345, H-45533, H-45540, H-45557, H-45776, H-46198, H-46262, H-48639, H-49778, H-49779, H-50780, H-51321, H-51526, H-52102, H-52135, H-52409, H-52928, H-53903, H-54755, H-56655, H-63626, H-66714, H-67026, H-67056, H-67304, H-67348, H-67457, H-68575, H-68602, H-70776, H-70984, H-72762, H-76451, H-76452, H-84557, H-84651, J-32706, J-43002, J-43547, J-44672, K-07605, N-20040, N-66718

PEROXYBUTYL NITRATE N-66750

PERSONNEL B-37603, B-51845, C-36002, C-46034, C-84463, D-26702, D-29040, G-30183, G-32152, L-06754, L-24122, L-24481, L-39749, L-52026, L-59722, N-37027

PERSONNEL QUALIFICATIONS L-60630

PEST CONTROL (BUILDINGS) N-12307

PESTICIDES A-23561, A-42680, A-44566, A-45145, A-47959, A-71262, A-71273, B-26911, B-45707, B-51845, B-60864, C-26203, C-27248, C-52629, C-61692, C-67116, G-24392, G-26274, G-39497, G-43277, G-57701, G-61467, H-04544, H-08884, H-17710, H-24282, H-39782, H-49647, H-56637, H-56788, H-83145, K-69550, L-48788, N-66750

PETER SPENCE PROCESS (CLAUS) A-43014, B-24033, B-67700

PETROLEUM AND COAL PRODUCTS INDUSTRY A-09785, A-13699, A-23865, A-24370, A-25305, A-29786, A-39460, A-40159, A-40344, A-42675, A-45858, A-47143, A-47963, A-49924, B-26908, B-44979, B-45707, B-49031, D-31371, D-37994, D-40896, D-49860, G-36751, G-44867, G-68583, H-40472, H-45130, I-07553, J-48171, K-58899, L-39749, L-43007, L-47380

PETROLEUM DISTRIBUTION A-40344, A-47143, L-25427, L-32173, L-32245

PETROLEUM PRODUCTION A-02312, A-30517, A-40159, A-46558, A-47143, L-47380

PETROLEUM REFINING A-09785, A-13699, A-23865, A-24370, A-25305, A-29786, A-39460, A-40159, A-40344, A-42675, A-45858, A-47143, A-47963, A-49924, B-26908, B-44979, B-45707, B-49031, D-31371, D-37994, D-40896, D-49860, G-36751, G-44867, G-68583, H-40472, H-45130, I-07553, J-48171, K-58899, L-39749, L-43007, L-47380

PETUNIA D-09590, H-01800, H-02537, H-12042, H-21364

PH A-00640, A-31315, A-72133, A-74154, B-17463, B-24834, B-36475, B-37164, B-38445, B-40712, B-41418, B-47086, B-47463, B-56057, C-00260, C-08077, C-18283, C-23654, C-24124, C-24331, C-24546, C-26485, C-27331, C-28374, C-37463, C-37515, C-41491, C-45802, C-48315, C-53625, C-64912, C-68944, C-80573, D-21419, D-30058, D-39054, D-44799, F-34948, G-24392, G-32152, G-74380, H-01705, H-15404, H-16399, H-16567, H-16673, H-28149, H-29736, H-36998, H-37403, H-38412, H-39098, H-39183, H-42086, H-42954, H-42958, H-45160, H-45467, H-64824, H-82498, I-40833, L-25542

PHENOLS A-32855, A-37190, A-39460, A-48116, A-52664, A-66977, A-79280, B-14692, B-62165, B-75204, C-09983, C-20030, C-31115, C-38670, C-39136, C-39516, C-42928, C-47218, C-48392, C-50936, C-61103, C-67116, D-17102, D-39737, D-50690, D-60574, D-63186, G-84260, H-07046, H-15404, H-25366, H-47014, H-84484, K-28466, K-74109, N-65407

PHENYL COMPOUNDS A-34334, A-47048, A-48572, A-72133, C-17128, C-32534, H-42857, K-51057, L-29504

PHENYLS A-34334, A-48572, A-72133, C-32534, H-42857, K-51057

PHILADELPHIA D-24736, D-52578, L-17614, L-44598

PHOSPHATIC FERTILIZER PLANTS A-76411, A-76459, A-79511, A-82269, A-82353, A-82944, A-84479, B-80863, B-81772, B-81773, B-81944, C-80935, G-79634, G-83798, H-79635, H-80064

PHOSPHINE C-79003, F-68048, L-82278

PHOSPHORIC ACID A-00340, A-03090, A-08116, A-09214, A-09321, A-09332, A-12749, A-12809, A-12813, A-12933, A-21380, A-30517, A-39460, A-40344, A-45858, A-46119, A-75089, B-06587, B-07190, B-07552, B-17485, B-22913, B-25038, B-26674, B-31708, B-32231, B-33918, B-36716, B-37080, B-37914, B-44793, B-47680, B-54799, B-58466, B-58632, B-67846, B-69131, C-44881, H-46997, I-40510, K-66916, L-29504

PHOSPHORIC ACID PLANTS A-76459, B-80863

PHOSPHOROUS ORGANIC COMPOUNDS A-42731, B-47466, C-35956, C-47218

PHOSPHORUS COMPOUNDS A-00340, A-02019, A-02847, A-03129, A-03450, A-03565, A-04068, A-05040, A-05090, A-05139, A-05140, A-05587, A-08116, A-09214, A-09651, A-09690, A-09692, A-09693, A-09694, A-09695, A-09697, A-10706, A-11541, A-12631, A-12741, A-12747, A-12749, A-12750, A-12809, A-12813, A-12822, A-12828, A-12884, A-12886, A-12888, A-12919, A-12929, A-12931, A-12933, A-13242, A-13353, A-15452, A-17076, A-18449, A-26258, A-26329, A-28282, A-30517, A-31529, A-35592, A-35985, A-36377, A-43816, A-44681, A-48429, A-52741, A-63661, A-63064, A-76411, A-76638, A-80238, A-81343, B-02962, B-06587, B-07190, B-09664, B-09902, B-17485, B-18144, B-18536, B-22598, B-23310, B-24117, B-24355, B-24834, B-32231, B-32232, B-32384, B-36475, B-36716, B-37080, B-37115, B-37745, B-38299, B-38587, B-39104, B-40251, B-43533, B-43972, B-46086, B-47095, B-51720, B-51845, B-58466, B-58632, B-65923, B-67742, B-84418, C-09560, C-11678, C-12100, C-14288, C-16801, C-22458, C-23573, C-24018, C-24114, C-26744, C-38280, C-39719, C-43979, C-61859, C-68086, C-79003, C-83442, D-01872, D-28188, D-52578, E-37037, F-13565, F-16218, F-22219, F-34948, F-68048, G-04983, G-06675, G-14126, G-26743, G-28037, G-33561, G-39833, G-80197, H-00979, H-01705, H-04544, H-04918, H-04919, H-04925, H-05004, H-06342, H-06354, H-07046, H-08513, H-10841, H-15501, H-21000, H-21498, H-24282, H-25750, H-26795, H-28446, H-28899, H-30301, H-30368, H-32673, H-33290, H-36787, H-37403, H-37567, H-38404, H-38417, H-38568, H-40201, H-51321, H-51484, H-51526, H-59935, H-75027, H-80536, J-39910, K-10168, K-28466, K-41682, K-44310, K-66916, L-29504, L-82278

PHOSPHORUS ORGANIC COMPOUNDS K-74109

PHOSPHORUS PLANTS A-76411

PHOTOCHEMICAL REACTIONS A-00220, A-00375, A-08882, A-09785, A-12557, A-23561, A-28038, A-29786, A-32060, A-36045, A-45145, A-47143, C-00126, C-09770, D-26702, D-34008, E-29774, E-77970, F-02337, F-02517, F-25636, F-53153, F-80516, G-19148, G-74290, H-01800, H-02179, H-05342, H-06557, H-07255, H-08884, H-12042, H-12415, H-19604, H-27303, H-29736, H-41699, H-45130, H-46198, H-46262, H-46338, H-51321, I-27060, K-07605, N-49170

PHOTOELECTRIC PHENOMENA C-61993, F-46162, F-53153, H-06459

PHOTOGRAPHIC METHODS C-56865, H-07047, H-46721, H-53903, H-70752

PHOTOIONIZATION D-34008
PHOTOLYSIS E-77970, F-25636, F-53153, F-80516, H-27303, K-07605
PHOTOMETRIC METHODS A-30218, A-42731, C-01313, C-01593, C-02681, C-04685, C-04687, C-04689, C-04692, C-04757, C-05439, C-05620, C-07763, C-10632, C-12100, C-17082, C-17092, C-18264, C-23767, C-24310, C-24315, C-24372, C-27248, C-28126, C-28671, C-29966, C-31115, C-32534, C-37350, C-38741, C-40211, C-41719, C-42926, C-43979, C-43986, C-44238, C-46443, C-47218, C-48492, C-48916, C-49391, C-49879, C-63848, C-71245, C-73471, C-78426, C-82273, C-83495, D-48850, E-04987, H-79974, L-17472, N-64545
PHOTOOXIDATION A-29786, C-00126, C-09770, D-34008, E-29774, F-02517, H-12042, H-41699
PHOTOSYNTHESIS B-02541, C-05892, G-01674, H-01664, H-01800, H-02379, H-03395, H-03611, H-03629, H-05324, H-06459, H-07255, H-08884, H-10673, H-16244, H-16245, H-16387, H-16399, H-19656, H-21093, H-22496, H-23950, H-23988, H-26711, H-27091, H-27324, H-27785, H-28888, H-30234, H-30806, H-31124, H-32714, H-33089, H-33468, H-33716, H-35964, H-36883, H-37403, H-38332, H-39466, H-39537, H-41189, H-41362, H-41696, H-41699, H-44345, H-45022, H-47014, H-48798, H-50415, H-55654, H-56204, H-56428, H-56655, H-60913, H-60961, H-62548, H-68575, H-69800, H-71931, H-78058, H-84290, K-07605
PHTHALIC ACID A-30517, B-45846
PHYSICAL THERAPY C-66753
PHYSIOLOGY G-80857
PHYTOTOXICANTS A-00220, A-02653, A-12557, A-45145, C-00126, C-02042, C-04687, C-04689, C-04757, C-11915, C-18283, C-28441, C-28462, C-67116, C-69152, D-10619, H-00240, H-00301, H-00964, H-00979, H-01250, H-01800, H-01809, H-02041, H-02049, H-03116, H-03395, H-03549, H-03611, H-03612, H-03613, H-03616, H-03629, H-03729, H-03860, H-04904, H-06413, H-06557, H-07255, H-08884, H-10673, H-11407, H-12042, H-12045, H-12155, H-16900, H-22789, H-25099, H-28476, H-32854, H-36994, H-38419, H-39782, H-40202, H-40341, H-41189, H-48798, H-49779, H-70487, H-78580
PILOT PLANTS B-07664, B-17485, B-24333, B-24355, B-26279, B-29680, B-33191, B-35111, B-37544, B-38587, B-40712, B-47086, B-56528, B-64696, B-65638, B-75387, B-76008
PINE TREES G-81181, H-78058, H-79635, H-80493, H-81771, H-82498, H-84558, H-84579
PINTO BEANS D-09590, H-00240, H-02382, H-03629, H-04728, H-05724, H-10150, H-12042, H-14247, H-17705, H-19657, H-21000, H-21364, H-21501, H-22284, H-23386, H-39098, H-45007, H-56241, H-60559
PITTSBURGH L-17614, N-04212
PLAINS H-51754
PLANNING AND ZONING A-03450, A-32519, A-47954, A-48849, B-09664, B-26911, D-23392, D-37607, H-21062, H-35964, H-41696, H-45345, H-46198, H-48022, H-50415, H-72762, K-10168, K-33107, L-09677, L-17614, L-32884, L-38573, L-46561, L-60630, L-81220, N-65407
PLANT DAMAGE A-00220, A-00375, A-01687, A-02653, A-02988, A-11453, A-12557, A-13699, A-17405, A-22973, A-26258, A-26329, A-28652, A-31144, A-31333, A-31935, A-32060, A-34018, A-34334, A-37190, A-45145, A-46119, A-52664, A-54622, A-58334, A-60281, A-70727, A-71262, A-71273, B-06587, B-09664, B-10618, B-15372, B-24033, B-25195, B-26911, B-28034, B-28502, B-28889, B-30814, B-38476, B-48879, C-00126, C-00941, C-04691, C-05586, C-06398, C-11915, C-18230, C-18283, C-24970, C-26713, C-27130, C-29426, C-33929, C-36800, C-39022, C-43981, C-56865, D-09590, D-23760, D-25093, D-26026, D-26086, D-26702, D-33108, D-35764, D-37473, D-37607, D-39737, D-42760, D-44799, D-48791, D-49860, D-52811, D-53889, D-56792, D-77485, D-78193, D-83399, D-84625, E-37037, E-49433, E-76047, F-55415, G-01338, G-01674, G-03246, G-05504, G-05833, G-11444, G-19055, G-19148, G-19215, G-22628, G-24580, G-26846, G-29043, G-32607, G-35569, G-36947, G-38616, G-40527, G-48030, G-48697, G-49448, G-51473, G-55517, G-60625, G-67325, G-67440, G-68551, G-74290, G-74359, G-78873, G-79980, G-81181, G-81250, H-00137, H-00187, H-00240, H-00265, H-00301, H-00600, H-00631, H-00633, H-00737, H-00788, H-00920, H-00979, H-01250, H-01398, H-01506, H-01557, H-01664, H-01705, H-01800, H-01809, H-02041, H-02049, H-02379, H-02537, H-03116, H-03360, H-03395, H-03472, H-03549, H-03571, H-03572, H-03611, H-03612, H-03613, H-03616, H-03629, H-03676, H-03729, H-03766, H-03860, H-03873, H-04403, H-04672, H-04678, H-04679, H-04732, H-04816, H-04904, H-04984, H-05324, H-05398, H-05399, H-05485, H-05585, H-05667, H-05724, H-06395, H-06404, H-06413, H-06557, H-07046, H-07047, H-08884, H-10342, H-10673, H-11456, H-11466, H-11650, H-12042, H-12045, H-12155, H-12415, H-13203, H-13474, H-13804, H-14121, H-14247, H-14678, H-14968, H-15213, H-15501, H-15838, H-16150, H-16222, H-16244, H-16245, H-16385, H-16387, H-16399, H-16472, H-16617, H-16673, H-16894, H-16896, H-17109, H-17163, H-17449, H-17684, H-17697, H-17705, H-17710, H-17749, H-17779, H-17822, H-17892, H-18226, H-18265, H-18267, H-18319, H-18704, H-18770, H-19124, H-19147, H-19211, H-19358, H-19539, H-19604, H-19656, H-19657, H-19713, H-19863, H-19949, H-20157, H-20158, H-20400, H-20708, H-20917, H-21062, H-21189, H-21194, H-21364, H-21500, H-21501, H-21687, H-22084, H-22092, H-22284, H-22496, H-22499, H-22624, H-22789, H-22887, H-22930, H-23188, H-23214, H-23222, H-23295, H-23386, H-23516, H-23576, H-23580, H-23639, H-23794, H-23852, H-23874, H-23950, H-23986, H-24024, H-24035, H-24036, H-24054, H-24358, H-24366, H-24395, H-24402, H-24533, H-24566, H-24787, H-24852, H-24933, H-25273, H-25499, H-25618, H-25661, H-25750, H-25769, H-25865, H-26055, H-26158, H-26491, H-26691, H-26711, H-26717, H-26800, H-26861, H-26978, H-27006, H-27021, H-27030, H-27303, H-27324, H-27526, H-27785, H-27805, H-27837, H-28475, H-28476, H-28477, H-28479, H-28480, H-28483, H-28647, H-28802, H-28830, H-28888, H-28899, H-29206, H-29277, H-29443, H-29597, H-29616, H-30142, H-30225, H-30298, H-30299, H-30301, H-30368, H-30473, H-30805, H-31124, H-31448, H-31733, H-32280, H-32282, H-32286, H-32334, H-32339, H-32343, H-32344, H-32516, H-32535, H-32536, H-32539, H-32714, H-32771, H-32854, H-32982, H-33089, H-33127, H-33468, H-33716, H-33906, H-34121, H-34880, H-35578, H-35613, H-35877, H-35880, H-35964, H-35992, H-36159, H-36742, H-36787, H-36883, H-36994, H-36998, H-37346, H-37403, H-37792, H-38017, H-38332, H-38343, H-38407, H-38411, H-38412, H-38419, H-38568, H-38574, H-39183, H-39190, H-39363, H-39466, H-39537, H-39684, H-39782, H-39887, H-39902, H-39932, H-39986, H-40202, H-40341, H-40472, H-40599, H-40899, H-41362, H-41370, H-41439, H-41482, H-41696, H-41698, H-41699, H-41983, H-42086, H-42601, H-42923, H-42954, H-42959, H-43492, H-43622, H-43663, H-44295, H-44345, H-44411, H-44595, H-45007, H-45022, H-45130, H-45160, H-45214, H-45345, H-45467, H-45474, H-45540, H-45557, H-45604, H-45776, H-45781, H-46051, H-46198, H-46217, H-46262, H-46338, H-46557, H-46719, H-46732, H-46923, H-47014, H-47286, H-47385, H-47806, H-48022, H-48193, H-48377, H-48403, H-48413, H-48556, H-48639, H-48798, H-49561, H-49644, H-49647, H-49778, H-49779, H-50157, H-50163, H-50415, H-50677, H-50780, H-51109, H-51271, H-51321, H-51470, H-51754, H-51953, H-52096, H-52102, H-52135, H-52409, H-52574, H-52651, H-52698, H-52705, H-52829, H-52928, H-52994, H-53370, H-53376, H-53903, H-54066, H-54297, H-54597, H-54755, H-54910, H-55066, H-55654, H-56204, H-56240, H-56241, H-56428, H-56584, H-56625, H-56637, H-56655, H-56788, H-56874, H-56885, H-56963, H-57475, H-57810, H-57859, H-58941, H-59028, H-59184, H-59327, H-59935, H-60559, H-60560, H-60907, H-60913, H-60957, H-60961, H-61410, H-61834, H-62275, H-62597, H-63167, H-63442, H-63626, H-64166, H-64427, H-64588, H-64758, H-64824, H-64860, H-65179, H-65380, H-65394, H-65558, H-65928, H-66714, H-66798, H-67026, H-67056, H-67304, H-67347, H-67348, H-67457, H-68122, H-68394, H-68575, H-68602, H-69162, H-69596, H-70279, H-70487, H-70607, H-70752, H-70984, H-72132, H-73518, H-74588, H-74617, H-74624, H-74626, H-74721, H-74722, H-76451, H-76452, H-76715, H-76838, H-77325, H-77390, H-77391, H-78580, H-78681, H-78956, H-79309, H-79338, H-79635, H-79972, H-79973, H-79974, H-79976, H-80067, H-80083, H-80189, H-80493, H-80575, H-80711, H-81495, H-81671, H-82208, H-82435, H-82520, H-83145, H-83721,

H-83730, H-83797, H-84048, H-84089, H-84290, H-84527, H-84545, H-84553, H-84557, H-84558, H-84650, H-84651, I-24308, J-32706, J-38409, J-43002, J-43547, J-44672, J-55161, J-60298, J-67865, K-03582, K-07605, K-08420, K-13173, K-26738, K-31968, K-67267, K-71991, L-06754, L-24010, L-25642, L-41455, L-42021, L-42188, L-44598, L-78484, L-81399, N-04212, N-12307, N-17260, N-20040, N-28923, N-44066, N-64545, N-64937, N-65407, N-66718

PLANT GROWTH B-28034, B-39104, C-16109, H-04544, H-08513, H-28830, H-69966, L-37747

PLANT GROWTH AND DEVELOPMENT H-76452, H-81495, H-81771, H-84290, H-84484, H-84553

PLANT INDICATORS A-13353, A-83543, B-15372, B-25195, C-05586, C-11915, C-26400, C-26909, C-29771, C-36693, C-36800, C-38278, C-39022, C-39762, C-43981, C-72017, D-24717, D-27254, D-58427, D-71272, E-76047, G-05504, G-48030, G-57299, H-04732, H-06557, H-10673, H-13804, H-14678, H-16385, H-16387, H-16567, H-17697, H-17779, H-17892, H-19211, H-19604, H-20476, H-21364, H-21422, H-22789, H-22887, H-23222, H-23576, H-23794, H-23950, H-23986, H-24035, H-24036, H-24358, H-24362, H-24533, H-24566, H-25230, H-25499, H-25661, H-25865, H-26158, H-26718, H-26861, H-27030, H-27091, H-28437, H-28477, H-30297, H-30473, H-32280, H-32854, H-33089, H-38419, H-39328, H-39782, H-41370, H-41698, H-42923, H-42954, H-45345, H-45540, H-46196, H-46338, H-46721, H-48291, H-48639, H-50157, H-51754, H-52096, H-52409, H-52705, H-54597, H-57716, H-57810, H-58777, H-59184, H-59327, H-59947, H-60690, H-61834, H-65179, H-66714, H-67304, H-67347, H-67480, H-68575, H-68602, H-69488, H-70279, H-70752, H-70776, H-71078, H-71098, H-72762, H-73518, H-74459, H-74624, H-74721, H-74722, H-78402, H-79635, H-80067, H-80083, H-80085, H-81771, H-82146, H-82498, H-83723, H-84290, H-84548, H-84551, H-84579, H-84650, I-24308, I-63139, K-13173

PLASTICS A-03129, A-08486, A-08816, A-34334, A-37562, A-47048, A-48231, A-48572, A-50938, A-50961, A-51102, A-61570, A-71615, A-72133, B-08344, B-33918, B-49929, B-50435, B-55046, B-59230, B-60864, B-61259, B-61954, C-04540, C-08077, C-66753, D-09590, G-01096, G-24153, G-45683, H-69966, I-39031

PLASTICS MATERIALS AND RESINS PLANTS A-79280

PLASTICS MATERIALS AND SYNTHETIC PLANTS A-79280

PLASTICS PRODUCTION A-79280

PLATING AND POLISHING A-09785, B-36532, B-66592, G-81181, I-39031, L-37747

PLUME BEHAVIOR B-04853, C-04691, C-05586, C-22877, C-48392, E-78793, F-04768, H-00631, H-00633, H-00788, H-00920, H-01705, H-02200, H-03549, H-03571, H-03572, H-03616, H-04678, H-04679, H-04683, H-04688, H-04728, H-04732, H-04984, H-05398, H-05585, H-05724, H-06413, H-08513, H-08884, H-16244, H-16399, H-26800, H-29616, L-19064, L-80894

PNEUMOCONIOSIS A-22875, B-19177, C-30432, G-07344, G-18809, G-18987, G-32256

PNEUMONIA A-63661, D-33309, G-01047, G-41684

POINT SOURCES D-09590, D-23760, D-24717, D-49860, E-44277, E-78943, H-80189, H-80575, L-40889

POLAND A-79511, A-84479, H-84477

POLAROGRAPHIC METHODS A-75077, B-29680, C-09983, C-27248, C-30793, C-32534, C-35956, C-39719, C-39762, C-43985, C-46034, C-47218, C-49509, C-53523, C-53625, C-53987, C-64779, C-74346, C-75339, D-28097, E-04987, H-39328, H-50729

POLLEN COLLECTORS C-42926

POLLENS A-00375, A-32702, A-34018, A-69039, A-71273, C-67116, D-19966, G-01794, G-07098, G-38721, G-61467, H-47806, N-66750

POLLUTION PRECURSORS A-13615, B-02541, C-00126, C-05892, C-18230, C-66753, D-26026, G-01674, H-00187, H-00633, H-00737, H-01250, H-01664, H-01705, H-01800, H-02379, H-03360, H-03395, H-03472, H-03611, H-03629, H-03860, H-04678, H-04679, H-05324, H-05744, H-06342, H-06459, H-07255, H-08884, H-09683, H-10342, H-10673, H-11100, H-11407, H-14247, H-14678, H-15213, H-15501, H-16092, H-16222, H-16244, H-16245, H-16387, H-16399, H-16472, H-16567, H-16673, H-16896, H-16900, H-17749, H-18265, H-18267, H-18507, H-19656, H-19657, H-20708, H-21000, H-21093, H-21498, H-21501, H-21687, H-22496, H-22624, H-23188, H-23214, H-23639, H-23794, H-23950, H-23988, H-24366, H-24548, H-25499, H-25618, H-26055, H-26158, H-26175, H-26711, H-26861, H-26978, H-27091, H-27303, H-27324, H-27526, H-27785, H-27805, H-28409, H-28427, H-28443, H-28483, H-28802, H-28888, H-29206, H-30225, H-30234, H-30368, H-30806, H-31124, H-31448, H-32516, H-32536, H-32539, H-32714, H-32771, H-33089, H-33468, H-33716, H-34880, H-35578, H-35964, H-36883, H-36994, H-36996, H-37403, H-38332, H-38568, H-39363, H-39466, H-39537, H-41189, H-41362, H-41370, H-41696, H-41698, H-41699, H-42086, H-42923, H-43493, H-44345, H-45022, H-45160, H-45474, H-45557, H-46262, H-46338, H-47014, H-47385, H-47806, H-48022, H-48556, H-48798, H-50157, H-50415, H-51953, H-52651, H-52705, H-54910, H-55066, H-55654, H-56204, H-56428, H-56637, H-56655, H-56874, H-56885, H-56963, H-57475, H-57810, H-59327, H-60913, H-60961, H-61410, H-62275, H-62548, H-63167, H-63442, H-64860, H-68575, H-69481, H-69800, H-70487, H-71098, H-71931, H-74617, H-74626, H-75027, H-78058, H-78402, H-79338, K-07605, N-66750

POLYNUCLEAR COMPOUNDS A-00375, A-29786, A-34018, A-38657, A-41877, A-46925, B-45707, B-75204, C-01593, C-04463, C-06112, C-26707, C-27294, C-35956, C-39762, C-48916, C-67116, C-84660, D-28097, D-31396, D-32666, D-34008, D-50307, G-07098, G-11942, G-31319, G-41706, G-49756, G-60625, G-71484, G-73658, G-78873, G-84233, H-39328, J-42746, L-33495, L-84415, N-04212, N-17260, N-46820, N-49170, N-65407

POTASSIUM COMPOUNDS A-37190, A-43403, A-51100, A-52741, A-75077, A-76411, A-79567, A-80994, B-30276, B-32384, B-77838, C-04692, C-07860, C-09770, C-12593, C-23096, C-24018, C-25223, C-26729, C-75339, C-83442, D-33017, E-40271, E-43424, G-00165, H-00979, H-15213, H-16150, H-24282, H-28446, H-30368, H-39098, H-45160, H-47806, H-52651, H-63442

POTATOES (IRISH) G-11444, H-04984, H-11466, H-15604, H-22624, H-30805, H-52306, H-80536

POTENTIOMETRIC METHODS A-61564, A-75077, B-29680, C-07871, C-08077, C-12334, C-12760, C-18344, C-20892, C-20895, C-21156, C-25210, C-27341, C-27962, C-28374, C-28843, C-29198, C-31712, C-33632, C-35956, C-37350, C-37579, C-39008, C-39022, C-39243, C-39719, C-39762, C-41064, C-41491, C-43779, C-43985, C-43986, C-44933, C-47218, C-51599, C-51762, C-52629, C-57781, C-58278, C-59049, C-60951, C-61896, C-61995, C-63848, C-64912, C-68229, C-69174, C-69675, C-69765, C-70638, C-71232, C-71245, C-73349, C-74221, C-75339, C-77427, C-83495, D-61140, G-71324, G-74380, H-39328, H-42946

POULTRY G-03394, H-00600, H-04544, H-13159, H-13203, H-28679, H-37480, H-43226, H-67453

PRECIPITATION A-00220, A-07650, A-30218, A-31144, A-31315, A-44566, A-47061, A-48048, A-74154, A-80507, B-10618, B-25195, C-18344, C-39239, C-39243, C-44177, C-48392, C-51599, C-68944, C-69174, D-09590, D-21419, D-23760, D-23862, D-24717, D-30705, D-33309, D-39054, D-39182, D-44799, D-50744, D-71348, D-77485, E-05054, E-29774, E-29910, E-37013, E-37639, E-40271, E-43424, E-78933, G-74369, H-10673, H-16567, H-19147, H-19539, H-20917, H-24282, H-25769, H-27030, H-30301, H-32535, H-32536, H-33290, H-36998, H-38574, H-42954, H-45007, H-52705, H-56428, H-61000, H-62597, I-46606, I-54961, J-55161, K-10168, L-25542, N-04212, N-66750

PRESSURE (ATMOSPHERIC) C-68944, G-68583, H-31733

PRIMARY SMELTING AND REFINING OF NONFERR A-83637, B-76232, B-80213, B-81995, B-83134, G-83798, G-84233, H-79129, H-83730, H-83851, J-76213, K-81864, K-84395

PRIMATES (NON-HUMAN) G-03394, G-30841

PROCESS MODIFICATION A-04068, A-11590, A-17377, A-33853, A-37562, A-42683, A-42751, A-44566, A-46925, A-47048, A-47188, A-47962, A-48231, A-48429, A-49852, A-50381, A-52912, A-55601, A-60281, A-60846, A-61154, A-64926, A-84479, B-07664, B-15322, B-18144, B-18826, B-18830, B-19177, B-21795, B-24116, B-25523, B-26911, B-29680, B-33554, B-35111, B-36532,

B-36716, B-37164, B-37914, B-38775, B-40892, B-42172, B-43108, B-43840, B-44638, B-44979, B-45380, B-45707, B-47125, B-47731, B-49031, B-49929, B-51845, B-55180, B-58380, B-58993, B-59230, B-60282, B-61259, B-62165, B-62786, B-65640, B-70428, B-71796, B-72656, B-76232, B-77816, B-77838, D-25593, H-00301, N-46820, N-64545, N-64937
PROPANES E-76047, G-28041, G-44867, G-84260
PROPENES B-59230, H-52409, H-52928
PROPOSALS D-14066, K-84395, L-48719, N-16400
PROTEINS A-11916, C-03478, C-42928, F-22219, G-01338, G-01426, G-52638, G-74822, G-80197, H-04728, H-05398, H-05399, H-19703, H-52306, H-62548, H-79972, H-83723
PUBLIC AFFAIRS A-32855, A-44566, A-47143, B-09664, B-26911, B-28034, D-30705, D-47976, G-29043, G-49164, G-50371, L-06938, L-29598, L-37943, M-68522, N-04212, N-28923
PUBLIC INFORMATION A-44566, B-26911, B-28034, N-04212
PULMONARY EDEMA A-00375, G-00165, G-01047, G-08702, G-11467, G-21455, G-30788, G-30841, G-33276, G-33505, G-40597, G-50916, G-79619, H-04544, H-08884, H-11452, K-41267
PULMONARY FUNCTION A-00375, A-17405, G-00165, G-01047, G-07013, G-08702, G-12403, G-12532, G-23003, G-26846, G-28139, G-28754, G-32256, G-38106, G-60228, G-79980, H-03766, H-17749
PULMONARY RESISTANCE A-00375
PULP MILLS A-03129, A-26254, A-36377, A-40344, A-45858, A-46558, A-47963, B-44979, B-45544, B-45707, B-47731, C-35956, D-09658, D-33108, J-46171, K-51212, L-20273, L-37747, L-47380
PULSE RATE G-01426, G-23711
PULVERIZED FUELS A-32702, B-33554
PYRENES A-00375, A-29786, A-34018, A-38657, C-26707, C-27294, C-39762, C-48916, C-84660, D-28097, D-32666, D-34008, D-50307, G-11942, G-41706, G-49756, G-60625, G-71484, H-39328, L-84415, N-04212, N-46820
PYRIDINES A-39460, C-80259, L-29504
PYROLYSIS A-48116, A-48572, B-43972, B-79711, B-82446, C-04463, C-06279, C-24008, C-24456, C-24546, C-31712, F-01677, G-08702

Q

QUALITY ASSURANCE C-84499
QUARTZ A-39460, C-11404, C-18264, C-43234, G-08201, G-10362, G-32256, G-52638, G-68583
QUENCHING A-41877, C-06397, C-24124, C-25668, C-31827
QUESTIONNAIRES A-02312, A-35212, B-59459, D-47976, G-40920
QUINONES C-04405, C-04463

R

RABBITS C-07719, G-01426, G-03246, G-03394, G-07917, G-08031, G-10247, G-13215, G-24392, G-33510, G-36723, G-40635, G-44594, G-49223, G-70519, H-12540
RADIATION COUNTERS C-04405, C-07860, K-19818
RADIATION MEASURING SYSTEMS C-04405, C-07860, C-26707, C-35956, C-36125, C-64779, D-30058, D-33080, E-33579, H-50503, H-50505, K-19818
RADIOACTIVE RADIATION A-32060, A-32139, A-37996, A-44566, A-45145, A-59921, A-79043, A-81931, B-28320, B-45468, B-55180, B-71841, C-04405, C-07860, C-11626, C-17117, C-26707, C-27294, C-32534, C-32966, C-35956, C-42375, C-44710, C-50093, C-53523, C-64779, C-68944, C-82650, D-07579, D-19966, D-30058, D-34008, D-52578, D-56463, D-56464, D-56465, E-30126, E-33579, E-40271, F-69599, G-02539, G-03394, G-07013, G-07961, G-28429, G-33561, G-37791, G-38721, G-39833, G-43323, G-49164, G-61467, H-02382, H-04544, H-05399, H-10150, H-42857, H-50503, H-50505, K-10168, L-06349, L-25542, L-57270, N-66750
RADIOACTIVE TRACERS C-07860, C-32966, E-30126, E-33579, G-33561, H-02382, H-05399, H-10150
RADIOGRAPHY G-06485, G-06497, G-06675, G-07344, G-08702, G-10203, G-10247, G-30183, G-36947, G-38942, G-40920, G-44590, G-49164, G-50371, H-01092, H-05004, H-25945
RADIOSONDES C-26713
RADON C-27294, E-77970, G-07961, G-37791
RAGWEED POLLEN G-01794
RAILROAD VEHICLES A-09785, H-39537
RAIN A-07650, A-30218, A-31144, A-31315, A-44566, A-47061, B-25195, C-18344, C-48392, C-51599, C-69174, D-21419, D-23760, D-24717, D-30705, D-39054, D-39182, D-50744, D-71348, D-77485, E-05054, E-43424, G-74369, H-10673, H-16567, H-19147, H-19539, H-20917, H-24282, H-27030, H-30301, H-33290, H-36998, H-56428, I-54961, J-55161, N-04212
RANKINE CYCLE ENGINES B-75138
RAPPING B-32627, B-38115, B-45544, B-64977, B-66624
RATS A-11916, B-75138, C-07719, G-01047, G-01426, G-03394, G-04734, G-06288, G-07013, G-07917, G-08030, G-08031, G-08201, G-10362, G-12282, G-12403, G-13700, G-14126, G-14319, G-16047, G-23711, G-28041, G-30145, G-30841, G-32256, G-33276, G-33510, G-33511, G-36411, G-40635, G-41036, G-41224, G-41684, G-41685, G-41686, G-41687, G-41688, G-44593, G-44594, G-45055, G-45683, G-49223, G-52147, G-52686, G-59073, G-66668, G-71948, G-72083, G-79619, G-79623, G-79796, H-54597
REACTION KINETICS A-05811, A-27930, A-77993, B-24355, B-38587, C-31827, C-39719, F-01677, F-02337, F-02517, F-16370, F-46162, F-53153, F-78035, F-80516, F-81069, G-28037, H-10150, H-71931
REACTION MECHANISMS A-05811, A-05871, A-36045, A-49886, A-55407, A-61800, B-67136, C-04405, C-26259, C-26729, C-29771, C-39719, D-34008, E-29774, E-37037, F-01677, F-02337, F-02517, F-03062, F-22219, F-32952, F-39861, F-41543, F-53153, F-59528, F-69599, G-01728, G-28037, G-34861, G-60748, H-26055, H-28888, H-52397, H-56241
REACTORS (NUCLEAR) B-12127, D-56464, F-13998, H-23624
RECOMBINATION C-31827
RECORDING METHODS B-60849, C-01313, C-06279, C-11041, C-11779, C-20540, C-25647, C-28530, C-48392, C-49879, C-56465, D-32679, E-04987, H-07047, H-41370, H-46721, H-53903, H-70752, N-64545
RECREATION AREAS C-11915, D-37607, G-14477, K-69550, L-06349
REDUCTION A-01125, A-18656, B-11686, B-12465, B-24116, B-47680, B-60282, B-60864, B-63474, C-01349, C-09770, E-33579, F-41543, G-08030, H-06459, H-07047, H-23950, I-00695
REFRACTORIES A-17377, A-42677, A-43272
REFUSE SYSTEMS A-03450, A-05601, A-08816, A-09785, A-11590, A-11876, A-12773, A-12889, A-22875, A-23865, A-25305, A-26254, A-29532, A-29786, A-30218, A-31529, A-32702, A-32855, A-34018, A-34334, A-35985, A-36377, A-37562, A-40344, A-40401, A-42675, A-45858, A-47048, A-47143, A-47188, A-47954, A-47963, A-48231, A-50013, A-50381, A-50938, A-50961, A-51100, A-51102, A-51137, A-52508, A-52741, A-53295, A-54622, A-55601, A-60727, A-67940, A-71262, A-71615, A-74262, A-80994, A-81745, A-81917, A-82192, B-24683, B-25038, B-25638, B-29680, B-32232, B-35111, B-36552, B-36716, B-37536, B-38439, B-43840, B-44716, B-44979, B-47677, B-47680, B-49929, B-49979, B-50154, B-50927, B-51101, B-51845, B-55180, B-56078, B-58879, B-59845, B-61259, B-61954, B-64696, B-68795, B-70840, B-71796, B-73031, B-74480, B-74483, B-78814, B-78890, B-79657, B-79711, B-80500, B-80950, B-81256, B-82446, B-83667, C-22812, C-23683, C-35956, C-36002, C-40211, C-44238, C-52992, C-75339, C-80935, D-09590, D-25593, D-37994, D-49860, D-71272, G-31319, G-32607, H-01398, H-40460, H-42923, I-65935, J-30696, J-48171, K-10168, K-37472, K-51212, K-51229, K-72151, K-78880, L-09677, L-29421, L-32173, L-32245, L-32272, L-37747, L-40461, L-48788, L-77234
REGIONAL GOVERNMENTS D-09590, D-26702, D-35764, K-33107, K-42039, L-19064, L-27677, L-29421, L-29598, L-32884, L-42188, L-47380, L-52026, L-81399
REGULATIONS A-01528, A-01687, A-03129, A-03450, A-22547, A-32139, A-33853, A-35985, A-36377, A-41650, A-41877, A-42675, A-42680, A-43014, A-44490, A-76274, B-25135, B-25638, B-46050, B-72139, B-81040, C-31115, C-39516, C-41763, D-25593, D-26702, D-47976, H-43622, K-19750, K-42039, K-58899, L-06938, L-06939, L-09677, L-19064, L-19434, L-27677, L-29504, L-29818, L-31492, L-32173, L-32245, L-32272, L-32354, L-32789, L-32884, L-33722, L-35795, L-37747, L-37943,

L-38669, L-39306, L-41455, L-42021, L-42188, L-42873, L-46561, L-46586, L-47380, L-48719, L-57270, L-60630, L-73839, L-76965, L-77817, N-21287, N-46820
REINLUFT PROCESS A-34334, B-26908
REMOTE SENSING C-79842, C-79843, C-83495
RENDERING PLANTS, GREASE AND TALLOW A-09785, A-22973, A-71262, L-09677
REPRODUCTION (BIOLOGICAL) B-09664, G-30385, G-37240, G-44593, G-56934, G-57701, G-64484, G-74823, G-79980, H-01092, H-04997, H-05004, H-06353, H-06354, H-18269, H-24944, H-27526, H-27805, H-31448, H-49573, H-51905, H-56521, H-64427
RESEARCH INSTITUTES D-29040, D-34008, L-06754, L-42810
RESEARCH METHODOLOGIES B-43863, C-02042, C-19076, C-49476, D-50307, D-62438, G-16345, G-28037, G-36947, G-49607, H-00137, H-02049, H-05421, H-17684, H-24035, H-27006, H-35992, H-36785, H-37792, H-38419, H-39782, H-40460, H-46262, I-00695
RESEARCH PROGRAMS A-01528, A-39460, A-44566, A-47143, A-47188, B-25038, B-26911, B-47086, B-47731, B-72139, C-61692, D-14066, D-83399, G-02539, H-16385, H-16673, H-18507, H-40368, H-43226, H-45557, H-50157, L-06754, L-42188, L-42810, L-43007, L-44598, L-48719, L-48788, L-52026, L-61705, L-77234, L-84415, N-37027
RESIDENTIAL AREAS C-25487, D-09590, D-23392, D-31371, D-37502, D-37607, D-47982, D-69744, G-14477, G-18988, G-29415, G-31234, H-32672, H-41904, H-48941, H-51754, L-06349, L-09677, L-44054
RESIDENTIAL SOURCES L-80594
RESIDUAL OILS A-29519, A-29786, A-31144, A-56192, A-61154, B-60255, B-60849, B-61935, D-33108, D-39054, D-39737, D-40896, K-31968, L-29598, L-32884, L-37747
RESPIRATION (PLANTS) H-01250, H-01800, H-03570, H-03571, H-03572, H-03611, H-03629, H-04728, H-05398, H-05744, H-06459, H-07046, H-10150, H-11100, H-14121, H-15404, H-16245, H-16387, H-16399, H-17970, H-26711, H-26800, H-27091, H-27324, H-28427, H-28888, H-29616, H-30234, H-30368, H-31124, H-32897, H-33716, H-35964, H-36742, H-39098, H-39190, H-39466, H-39902, H-41699, H-45022, H-50415, H-56204, H-60907, H-78058, H-83723, K-07605
RESPIRATORY DISEASES A-00375, A-07357, A-22875, A-22973, A-28038, A-34018, A-63661, A-69039, A-72079, A-79511, B-19177, C-30432, D-17642, D-31396, D-33108, D-33309, D-47976, G-00165, G-01047, G-01794, G-02539, G-05833, G-06675, G-07013, G-07344, G-07961, G-08702, G-10203, G-11467, G-11942, G-16345, G-16874, G-18785, G-18809, G-18987, G-18988, G-21455, G-28139, G-28199, G-29043, G-30788, G-30841, G-32256, G-33276, G-33505, G-33872, G-35569, G-36751, G-38616, G-39494, G-40597, G-40920, G-41684, G-41706, G-43636, G-44867, G-47905, G-48068, G-48636, G-48637, G-49164, G-50371, G-50916, G-52638, G-57024, G-60228, G-61467, G-66044, G-73658, G-74290, G-74369, G-79619, G-83798, G-84137, G-84233, H-03766, H-04544, H-08884, H-11452, H-32982, H-42857, J-30226, K-41267, L-83965, N-20040, N-64937
RESPIRATORY SYSTEM A-17357, A-27314, A-63661, C-07719, C-36771, G-00165, G-01047, G-02539, G-04849, G-04983, G-06288, G-06497, G-07013, G-07098, G-07344, G-07917, G-07961, G-08030, G-08031, G-08201, G-10203, G-10247, G-10362, G-11000, G-11467, G-11942, G-12572, G-18809, G-19880, G-21455, G-22553, G-22628, G-23003, G-25946, G-28199, G-28429, G-28556, G-29415, G-30788, G-30841, G-31319, G-32256, G-32596, G-32605, G-32607, G-33276, G-33505, G-33509, G-33511, G-33872, G-35569, G-36751, G-38616, G-38721, G-40597, G-41684, G-41688, G-41706, G-44594, G-44597, G-44867, G-45055, G-48068, G-48637, G-49164, G-49223, G-49448, G-49756, G-52686, G-57024, G-61467, G-66668, G-79619, G-79623, G-79980, G-83177, G-84260, H-00788, H-04923, H-08884, H-49434, L-29818, N-64545
RETENTION A-17405, A-74512, A-79043, B-33554, B-84391, C-37350, C-39762, C-60410, C-72017, D-53889, D-77485, E-49433, G-10247, G-10362, G-13700, G-14126, G-19880, G-22551, G-22629, G-28556, G-32256, G-32601, G-32606, G-37569, G-37684, G-41686, G-44593, G-44597, G-49607, G-50318, G-52686, G-54302, G-59073, G-60625, G-60748, G-61646, G-62177, G-64484, G-74580, G-80857, H-04917, H-04918, H-04919, H-04923, H-04924, H-13213, H-13474, H-15213, H-16152, H-18704, H-20015, H-20872, H-23661, H-23988, H-24282, H-25099, H-26742, H-26876, H-26916, H-30301, H-32539, H-32673, H-34880, H-35880, H-36883, H-36994, H-37480, H-37567, H-38332, H-38417, H-39183, H-39328, H-39493, H-39986, H-40368, H-40899, H-40916, H-41189, H-41439, H-42601, H-42946, H-43493, H-44428, H-45009, H-45604, H-48193, H-48291, H-48374, H-48403, H-48556, H-48798, H-48941, H-50163, H-50959, H-51271, H-51484, H-51754, H-52096, H-52102, H-52397, H-52829, H-52994, H-53025, H-53370, H-54066, H-54297, H-54597, H-56213, H-56240, H-56515, H-58506, H-58507, H-58941, H-60595, H-63442, H-65179, H-67480, H-68394, H-70279, H-70357, H-70745, H-74459, H-74617, H-74721, H-74722, H-77377, H-79129, H-81288, K-17375
RHODE ISLAND L-09677
RICE G-81181, H-79309, H-79586, H-79972, H-80064, H-80083, H-83730, H-83849, H-83851, H-83854, H-84553, H-84651
RINGELMANN CHART A-44490, C-35108, C-52992, C-59513, D-39737, L-09677, L-32173, L-32272, L-66700
RIVERS B-24683, B-28034, C-44710, D-09590, D-30058, D-42760, H-36996
ROADS A-36377, A-76274, C-39762, D-18537, D-22342, D-31371, D-33425, G-47807, H-26055, H-26092, H-40368, H-41904, H-48941, H-54397, H-56637, L-29421, L-29598
ROOTS H-79972, H-80085, H-80575, H-83885
ROSE H-80067, H-83721
ROTARY ENGINES D-34008
ROTARY PISTON ENGINES D-34008
RUBBER A-37190, A-40344, A-45858, B-59230, C-29771, D-09590, E-29774, H-40368, I-07533, I-24308, I-27060, I-40510, I-46606, J-30696
RUBBER AND MISCELLANEOUS PLASTICS PRODUC A-40344, A-45858, A-79280, B-44979, D-40896, I-23108
RUBBER PRODUCTION A-40344, A-45858, A-79280, B-44979, D-40896, I-23108

S

SAFETY EQUIPMENT A-27314, C-04405, G-01096
SALTZMAN METHOD (NO2) A-40471, C-22812, C-22877, C-26122, C-27248, C-30014, C-32476, C-43985, C-49509, C-49992, C-61993, D-19966, H-07255, H-18319, K-08420
SAMPLERS A-02312, A-11877, A-31529, A-40471, A-42731, A-43816, A-50018, B-22913, B-22943, B-26745, B-29680, B-37914, B-47466, C-00126, C-00626, C-00636, C-00941, C-01313, C-01593, C-02042, C-02681, C-03527, C-03550, C-04038, C-04540, C-04687, C-05317, C-05439, C-06962, C-07710, C-07871, C-09983, C-11404, C-11574, C-11779, C-12334, C-12451, C-22517, C-22812, C-22877, C-23096, C-23657, C-24603, C-25180, C-25487, C-26707, C-28251, C-28285, C-28374, C-28738, C-29426, C-29771, C-30300, C-30432, C-30958, C-32476, C-34125, C-34126, C-35108, C-35956, C-37579, C-37799, C-38278, C-39008, C-39022, C-39288, C-40409, C-40705, C-41624, C-42926, C-43986, C-44083, C-44238, C-44881, C-47218, C-48674, C-48916, C-49476, C-49752, C-49992, C-50922, C-51762, C-52206, C-53987, C-56244, C-60278, C-60410, C-60419, C-70638, C-70686, C-71244, C-72015, C-80573, C-82650, C-84175, C-84463, D-01872, D-09590, D-19966, D-26026, D-28771, D-30058, D-30705, D-33858, D-39182, D-43317, D-49260, D-52578, D-52811, D-58427, E-04987, F-34948, G-06485, G-08031, G-19215, H-00631, H-18319, H-24362, H-30142, H-60907, I-00695, K-08420, L-24481, N-04212
SAMPLING PROBES A-12692, A-30218, A-40600, C-05317, C-06494, C-35956, C-39008, C-52206, C-63848, C-82650, H-02379
SAN FRANCISCO A-47143, D-26702, H-00301, H-01809, H-68394, L-09677
SANITARY SERVICES A-03450, A-05601, A-08816, A-09785, A-11590, A-11876, A-12773, A-12889, A-22875, A-23865, A-25305, A-26254, A-29532, A-29786, A-30218, A-31529, A-32702, A-32855, A-34018, A-34334, A-35985, A-36377, A-37562, A-37996, A-40344, A-40401, A-42675, A-45858, A-47048, A-47143, A-47188, A-47954, A-47963, A-48231,

A-50013, A-50381, A-50938, A-50961, A-51100, A-51102, A-51137, A-52508, A-52741, A-53295, A-54622, A-55601, A-60727, A-67940, A-71262, A-71615, A-74262, A-75077, A-75146, A-80994, A-81745, A-81917, A-82192, B-24683, B-25038, B-25638, B-28502, B-29680, B-32231, B-32232, B-35111, B-36152, B-36716, B-37536, B-38439, B-43840, B-44716, B-44979, B-47677, B-47680, B-49929, B-49979, B-50154, B-50937, B-51101, B-51845, B-55180, B-56078, B-58879, B-59845, B-61259, B-61954, B-64696, B-68795, B-70840, B-71796, B-73031, B-74480, B-74483, B-78814, B-78890, B-79657, B-79711, B-80500, B-80950, B-81256, B-82446, B-83667, C-22812, C-23683, C-35956, C-36002, C-40211, C-44238, C-52992, C-75339, C-80935, D-09590, D-25593, D-37994, D-41979, D-49860, D-71272, G-31319, G-32607, H-01398, H-25366, H-40460, H-42923, H-43226, I-07553, I-39031, I-65935, J-30696, J-48171, K-10168, K-37472, K-51212, K-51229, K-72151, K-74109, K-78880, L-09677, L-25427, L-29421, L-32173, L-32245, L-32272, L-37747, L-40461, L-48788, L-77234

SCANDINAVIA A-00220, A-00640, A-05090, A-49886, A-55407, A-74262, B-15372, B-25195, B-49477, B-52179, B-67742, B-71297, C-00126, C-00260, C-00264, C-01313, C-01349, C-02042, C-02565, C-04405, C-04463, C-11626, C-44083, C-49476, C-52206, D-01872, D-78442, F-01677, F-02337, F-02517, F-03062, G-01096, G-01728, G-02539, G-03394, G-04145, G-84233, H-00301, H-00631, H-01800, H-02041, H-02379, H-02382, H-03571, H-32982, H-38412, H-38574, H-52705, H-80189, H-81771, I-00085, J-48171, K-68582, L-38573, L-44598, L-46586

SCATTERING (ATMOSPHERIC) A-08882, N-51942

SCOTCH PINE TREES H-81771

SCRAP YARDS A-47048, A-64926, B-58879

SCREEN FILTERS B-24110

SCRUBBERS A-00340, A-01125, A-01687, A-02847, A-04068, A-05040, A-05090, A-05139, A-05140, A-05587, A-05601, A-06371, A-08116, A-09214, A-09321, A-09332, A-09651, A-09690, A-09692, A-09693, A-09694, A-09695, A-09697, A-09799, A-11341, A-11541, A-11590, A-11876, A-12470, A-12474, A-12476, A-12622, A-12676, A-12741, A-12747, A-12749, A-12750, A-12809, A-12813, A-12822, A-12828, A-12884, A-12886, A-12888, A-12889, A-12919, A-12929, A-12931, A-12933, A-15452, A-17076, A-21380, A-22547, A-26136, A-31529, A-31935, A-32139, A-35985, A-37562, A-40159, A-40180, A-40344, A-40471, A-41650, A-41877, A-42751, A-43014, A-43270, A-43272, A-44490, A-46119, A-47962, A-47963, A-47966, A-48231, A-48429, A-52664, A-53874, A-55601, A-58939, A-60281, A-60727, A-60827, A-60866, A-63661, A-65064, A-70069, A-71262, A-71615, A-74154, A-74586, A-76122, A-76152, B-02962, B-04368, B-04794, B-06587, B-07190, B-07664, B-07815, B-08344, B-09773, B-09902, B-11686, B-12288, B-13676, B-15322, B-15372, B-15813, B-16962, B-17463, B-17485, B-18144, B-18641, B-18698, B-18699, B-18826, B-18830, B-19177, B-19212, B-21034, B-22040, B-22484, B-22598, B-22853, B-22913, B-22923, B-22943, B-23370, B-24033, B-24110, B-24116, B-24355, B-24834, B-25135, B-25195, B-26244, B-26279, B-26317, B-26401, B-26674, B-26745, B-27282, B-27835, B-28034, B-28320, B-28783, B-28786, B-29114, B-29680, B-29725, B-30276, B-30519, B-30814, B-31367, B-31708, B-31889, B-32231, B-32232, B-32384, B-32461, B-32712, B-33191, B-33918, B-33971, B-35106, B-35448, B-35513, B-36405, B-36475, B-36532, B-36552, B-36716, B-36755, B-37080, B-37115, B-37293, B-37402, B-37509, B-37544, B-37809, B-37914, B-38082, B-38115, B-38188, B-38439, B-38504, B-38587, B-38593, B-38874, B-40251, B-40414, B-40712, B-41378, B-41418, B-42104, B-42287, B-42458, B-43299, B-43481, B-43533, B-44343, B-44638, B-44716, B-44838, B-44979, B-45004, B-45078, B-45380, B-45544, B-45707, B-45757, B-45846, B-46050, B-46086, B-47054, B-47086, B-47095, B-47186, B-47256, B-47341, B-47463, B-47466, B-47677, B-47680, B-47821, B-48143, B-48805, B-48879, B-49023, B-49031, B-49420, B-49477, B-49929, B-49979, B-50154, B-50652, B-50868, B-50937, B-51101, B-52094, B-52172, B-52179, B-52838, B-52852, B-53620, B-53867, B-53868, B-53875, B-54310, B-54799, B-55180, B-55524, B-55678, B-56057, B-56064, B-56078, B-58879, B-59230, B-59845, B-59861, B-60075, B-60255, B-60282, B-61259, B-61273, B-61741, B-63474, B-63540, B-63775, B-63784, B-64092, B-64696, B-64898, B-64977, B-65638, B-65640, B-66592, B-67136, B-67137, B-67700, B-67742, B-68633, B-69131, B-69965, B-70428, B-70658, B-70840, B-71472, B-71796, B-72038, B-72656, B-73031, B-73175, B-74483, B-76008, B-76512, B-79657, B-80213, B-80356, B-81040, B-81256, B-81772, B-81773, B-82032, B-83134, B-83198, B-83613, B-83667, B-84418, C-00126, C-11041, C-23575, C-26692, C-28251, C-39022, C-52206, C-66753, D-30058, E-29315, F-44721, G-01674, G-40527, H-18319, I-39031, I-65935, J-29923, J-30226, J-39910, J-48171, K-66860, K-66916, K-78880, L-24481, L-32884, L-33722, N-46820

SEA BREEZE C-66753, D-48791, H-28149, H-32714

SEA SALTS A-48849, D-66083, H-16150, H-21189, I-40833, I-54961, I-58585

SECONDARY AIR A-37562, A-48231, A-49852

SECONDARY SMELTING AND REFINING OF NONFE A-82269, A-82353, A-82944, A-83637, B-77475, B-81645, B-82918, C-80935, G-83798, G-84233, H-79633, H-80064, H-80189, H-82208, H-83730, H-83851, H-84551, H-84553, J-76213, L-81399

SEDIMENTATION (CONTROL) B-29403, B-47677

SEDIMENTATION PHENOMENA A-32060, B-29114, B-29403, B-29725, B-32963, B-35106, B-38188, B-47677, B-47821, B-49023, B-62786, C-27044, D-32679

SELENIUM COMPOUNDS A-60729, A-68912, A-73078, A-75077, A-76638, A-80238, A-81343, B-18826, B-32461, B-75204, C-27294, C-55789, C-75339, D-52578, D-69144, G-36723, G-48068, G-52029, G-57701, G-71933, G-73658, G-80857, H-48374, I-08076, K-51057, K-68224, L-29504

SENATE HEARINGS C-44710, F-44721

SERVICE INDUSTRIES A-09785, A-34018, A-40344, A-45858, A-47143, N-04212, N-12307

SETTLING CHAMBERS A-15452, A-60827, B-29403, B-35106, B-38115, B-40251, B-45078, B-49023, B-53868, B-70428, B-70840

SETTLING PARTICLES A-00896, A-01528, A-02312, A-04068, A-05601, A-06371, A-08882, A-09715, A-11453, A-12622, A-15452, A-17076, A-17116, A-17344, A-17471, A-20134, A-22875, A-26254, A-28282, A-29519, A-29532, A-29786, A-31144, A-32060, A-32139, A-32519, A-32702, A-34018, A-34334, A-36377, A-37190, A-37562, A-37752, A-37996, A-38657, A-39460, A-40180, A-40182, A-40344, A-41877, A-42675, A-42676, A-42677, A-42680, A-42682, A-42683, A-42685, A-42731, A-42751, A-44490, A-44566, A-44605, A-46558, A-46925, A-47048, A-47188, A-47410, A-47945, A-47954, A-47962, A-47963, A-47965, A-47966, A-48231, A-48429, A-48849, A-48946, A-49617, A-49852, A-49924, A-50013, A-50381, A-50938, A-51100, A-52508, A-52741, A-52912, A-53295, A-59257, A-59494, A-59775, A-60281, A-60283, A-60727, A-60728, A-60729, A-60827, A-60866, A-61007, A-61154, A-61570, A-63661, A-64926, A-66955, A-66977, A-67940, A-68703, A-69039, A-69309, A-70727, A-71273, A-71615, A-72079, A-72125, A-72133, A-74262, A-75089, A-76274, A-76411, A-76638, A-77367, A-77522, A-80334, A-80994, A-81169, A-81343, A-81931, A-82192, A-82269, B-02541, B-04368, B-04794, B-07549, B-07664, B-08344, B-09902, B-10618, B-11686, B-13676, B-15322, B-17463, B-18144, B-18698, B-18699, B-18826, B-19177, B-19571, B-21795, B-22484, B-22943, B-23370, B-24110, B-25433, B-25590, B-25638, B-26279, B-26745, B-26911, B-27282, B-28786, B-29680, B-29725, B-30276, B-30519, B-30814, B-32231, B-32384, B-32461, B-32627, B-32963, B-33620, B-33918, B-33971, B-35106, B-35111, B-35513, B-36405, B-36716, B-37402, B-37603, B-37914, B-38082, B-38115, B-38439, B-38593, B-38874, B-40414, B-40892, B-42104, B-43108, B-44638, B-44716, B-45004, B-45380, B-45468, B-45544, B-45707, B-47086, B-47125, B-47256, B-47341, B-47463, B-47821, B-48805, B-48811, B-49023, B-49979, B-50154, B-53524, B-60255, B-60282, B-60849, B-60864, B-61259, B-63474, B-63784, B-64977, B-65638, B-65640, B-66624, B-67700, B-67742, B-67954, B-70428, B-70658, B-70840, B-71796, B-72038, B-72139, B-74480, B-74483, B-78814, B-79079, B-79657, B-79711, B-80356, B-80500, B-81040, B-81256,

B-81773, B-82446, B-83198, C-00450, C-01593, C-03527, C-09983, C-11915, C-16801, C-17098, C-20395, C-20892, C-22877, C-23575, C-26729, C-28671, C-29757, C-29738, C-30300, C-30432, C-32534, C-35108, C-35441, C-38741, C-41064, C-41763, C-43234, C-43570, C-44238, C-46443, C-48392, C-49509, C-49752, C-52206, C-52992, C-53625, C-55367, C-58278, C-58842, C-59814, C-61851, C-66606, C-68944, C-70686, C-76212, C-84660, D-09590, D-17102, D-19966, D-21419, D-22348, D-25593, D-28097, D-31396, D-32666, D-33017, D-33108, D-33309, D-33576, D-33858, D-34008, D-35764, D-39054, D-39182, D-39737, D-40896, D-44799, D-47976, D-49260, D-49660, D-50690, D-54881, D-56464, D-56792, D-60574, D-62438, D-63186, D-66083, D-67690, D-69144, D-70500, D-72286, D-73835, D-78193, D-78442, D-78954, D-79343, D-83399, E-29774, E-29910, E-33579, E-59234, E-62869, E-78933, F-59528, G-01794, G-02539, G-03394, G-04145, G-04734, G-06485, G-07013, G-07098, G-07344, G-07961, G-08201, G-08702, G-10362, G-11000, G-12532, G-14319, G-18809, G-18987, G-26274, G-28556, G-30183, G-30788, G-30841, G-31319, G-32605, G-32607, G-34398, G-37791, G-38721, G-39494, G-40527, G-40635, G-41706, G-43323, G-43636, G-48697, G-49164, G-49756, G-50318, G-50414, G-50916, G-52638, G-60228, G-60625, G-61146, G-61467, G-68583, G-72961, G-84137, G-84233, H-03116, H-03860, H-08884, H-11157, H-12533, H-16150, H-16673, H-19604, H-20707, H-20708, H-21189, H-27021, H-27324, H-28474, H-29736, H-30225, H-30805, H-32588, H-32982, H-35613, H-35964, H-36996, H-36998, H-37346, H-38332, H-38411, H-38417, H-38574, H-39190, H-39466, H-40368, H-41439, H-41983, H-42086, H-42601, H-42857, H-43622, H-45007, H-45160, H-45467, H-46338, H-46719, H-47014, H-47286, H-47385, H-48941, H-51754, H-52928, H-54297, H-54597, H-56637, H-56655, H-56885, H-60957, H-60961, H-61496, H-67433, H-68575, H-69596, H-69800, H-74626, H-77329, H-77391, H-79976, H-80575, H-81288, H-81671, H-81771, H-82520, H-83145, H-83258, H-84080, H-84290, H-84548, I-00695, I-24308, I-40833, I-54961, I-58585, I-63139, J-48171, K-08420, K-19750, K-27010, K-28466, K-31968, K-33107, K-34063, K-36823, K-38197, K-41682, K-42039, K-51057, K-51212, K-60180, K-68582, K-72151, K-80854, L-06349, L-06734, L-06754, L-09677, L-17188, L-17472, L-17614, L-19434, L-25542, L-25642, L-27677, L-28349, L-29421, L-29504, L-29598, L-29818, L-30620, L-32173, L-32245, L-32272, L-32789, L-3288 , L-35795, L-37747, L-37943, L-38668, L-39306, L-40461, L-41455, L-42021, L-42873, L-42874, L-44054, L-48719, L-52026, L-76397, L-76847, L-77234, L-80894, L-81220, N-04212, N-16400, N-21287, N-37027, N-50867, N-51942, N-64545, N-64937, N-65407

SEWAGE TREATMENT A-22875, A-32855, B-28302, I-07553, I-39031, K-74109

SEWERAGE SYSTEMS A-11590, A-11876, A-22875, A-32855, A-37996, A-75077, A-75146, B-24683, B-28502, B-32231, B-43840, B-80500, D-41979, H-25366, H-45226, I-07553, I-39031, K-10168, K-74109, L-25427, L-29421

SEWERS A-37996, D-41979, L-29421

SHEEP A-71273, G-03394, G-11467, G-15040, G-35569, H-00600, H-04544, H-11469, H-13159, H-17620, H-18271, H-25945, H-26795, H-30297, H-32291, H-43226, H-44428, H-67453

SHRUBS H-76297

SILICATES A-06371, A-09785, A-28282, A-39460, A-44681, A-82279, B-51720, C-04405, C-23657, C-38280, C-45760, C-46443, C-56244, F-20932, G-04145, G-04734, G-06485, G-39799, G-39924, G-71536, G-80197, H-24548, H-39887

SILICON COMPOUNDS A-02653, A-04068, A-05090, A-06371, A-09785, A-18449, A-21380, A-28282, A-30517, A-31134, A-39460, A-42731, A-44681, A-48048, A-50938, A-51100, A-52741, A-53955, A-61564, A-75077, A-79511, A-80994, A-81169, A-82279, B-06587, B-07552, B-08344, B-09902, B-19177, B-22913, B-26674, B-30519, B-31708, B-32384, B-36405, B-37745, B-38587, B-42287, B-43299, B-43863, B-45004, B-45254, B-46086, B-47054, B-48143, B-51720, B-53603, B-60075, B-63540, B-80356, C-00126, C-04405, C-04686, C-04687, C-04690, C-09983, C-18230, C-23657, C-33929, C-38280, C-39719, C-41763, C-45760, C-46443, C-56244, C-60010, C-60553, C-61851, C-64779, C-75339, C-80227, C-83442, D-17102, D-47982, D-52578, F-16218, F-20932, G-04145, G-04734, G-06485, G-16874, G-36723, G-37791, G-39799, G-39924, G-52764, G-54302, G-71536, G-80197, H-00301, H-04672, H-11456, H-16399, H-19539, H-24548, H-26055, H-30142, H-30368, H-35992, H-36998, H-39887, H-41904, H-43622, H-45160, H-47286, H-52928, K-42039, L-29504, L-32789, L-35795, L-37747, L-38669

SILICON DIOXIDE A-11916, A-40182, A-40344, A-60727, A-64926, A-71477, B-24834, B-37745, B-45757, B-46086, C-09983, C-36693, C-42928, C-49992, D-39737, F-20932, G-04734, G-08201, G-10362, G-32256, G-37791, G-48697, G-52638, H-16567, H-40202

SILICOSIS B-19177, C-30432, G-07344, G-18809, G-18987

SILVER COMPOUNDS A-09785, A-51100, A-75077, A-76638, A-81343, C-04405, C-09770, C-23096, C-30793, C-34125, C-75339, D-09590, E-29910

SILVER IODIDE C-04405

SIMULATION A-35985, A-75146, E-29315, E-29774, G-27379, H-11157, H-23516, L-73839

SINGLE CHAMBER INCINERATORS B-29680

SINTERING A-17344, A-17464, A-17471, A-30447, A-31333, A-37752, A-38657, A-39635, A-40182, A-40344, A-41877, A-43014, A-43272, A-45858, A-49617, A-75206, A-76122, A-76190, A-77522, A-81861, B-06587, B-10618, B-23182, B-24683, B-25433, B-25658, B-29680, B-40892, B-42172, D-39737, L-19434

SINUSES G-23003

SKIN (ANATOMY) A-00640, A-13701, B-28945, C-07719, G-01047, G-01794, G-03245, G-04983, G-06288, G-06485, G-07098, G-07344, G-08030, G-08031, G-10203, G-14319, G-18987, G-19880, G-23003, G-35569, G-37282, G-37795, G-40597, G-40635, G-44594, G-44597, G-49164, G-49223, G-56538, G-59073, G-84266, H-01092, H-12554, H-24944, K-41267, K-41295

SKIN CANCER A-00375

SKIN TESTS G-06675, G-07098

SLAUGHTERING PLANTS A-26254, A-34018, A-43270, B-26911, B-44716

SLUDGE A-11590, A-11876, A-75146, B-28502, B-32231, B-80500

SLUDGE INCINERATORS B-78890

SMOG A-00220, A-00896, A-01528, A-08882, A-09785, A-24033, A-29786, A-32060, A-32702, A-4714[illegible], B-02541, B-04853, C-24118, C-24279, C-43981, D-26702, D-48791, D-73835, D-84625, E-04987, E-29774, E-76047, G-01794, G-11467, G-19148, G-24580, G-26274, G-27379, G-28199, G-40597, G-41706, G-50916, G-60625, G-71484, G-74290, G-74369, G-84260, H-00301, H-01398, H-01800, H-02379, H-02537, H-03395, H-03472, H-03549, H-03611, H-03613, H-03616, H-04544, H-03485, H-05724, H-07255, H-08884, H-11157, H-11407, H-12045, H-12415, H-16244, H-17710, H-19604, H-20157, H-21364, H-22789, H-23516, H-23794, H-24358, H-24366, H-25865, H-26158, H-26861, H-28437, H-28475, H-28888, H-33089, H-33468, H-35613, H-39466, H-40341, H-43622, H-46198, H-49647, H-51953, H-52135, H-69800, H-79976, H-84651, I-07553, I-27060, I-54961, J-43002, L-17614, L-42188, L-50180, L-73839, L-81220, L-82278, N-04212, N-17260, N-28923, N-46820, N-49170, N-50867

SMOG INDEX A-00896

SMOKE SHADE A-33853, A-41650, A-44490, A-67748, A-67834, A-68823, C-01593, C-22877, C-35108, C-49879, C-52992, C-59513, C-69152, D-39757, K-03032, K-37472, K-51212, K-51229, K-66860, K-84395, L-09677, L-32173, L-32272, L-66700

SMOKEMETERS C-01593, C-32534, C-35108, C-49391, C-49879, C-59513, D-33309

SMOKES A-00220, A-01528, A-02312, A-08882, A-09785, A-17377, A-31144, A-32060, A-32702, A-36045, A-36377, A-39460, A-40180, A-47188, A-59494, A-60827, A-71273, A-71477, B-19177, B-26908, B-28786, B-30814, B-35106, B-42172, B-43481, B-44121, B-44979, B-45707, B-49023, B-49031, B-60255, B-81645, C-01593, C-03119, C-03527, C-22877, C-26713, C-28671, C-35108, C-41763, C-43981, C-49879, C-59513, C-80103, D-19145, D-21419, D-30705, D-33309, D-39737, D-41979, D-54881, G-11467, G-16345, G-26274, G-34398, G-38721, G-39494, G-61146, G-84137, H-00301, H-04816, H-08884, H-11157, H-11452, H-11650, H-12552, H-16092, H-16567, H-16673, H-19604, H-21189, H-23295, H-23874, H-27021, H-28802, H-28888, H-30225, H-30368, H-32343, H-35964, H-36742, H-36998, H-39190, H-39466, H-39537, H-39684, H-39887,

H-39902, H-41370, H-41696, H-43492, H-45467, H-48022, H-48167, H-48193, H-48413, H-52928, H-56428, H-57475, H-65103, H-68770, H-69800, H-73172, H-79976, H-81671, H-83145, H-83854, H-83856, K-03032, K-27010, K-31968, K-51212, K-74109, L-06349, L-09677, L-17188, L-19064, L-27677, L-29421, L-29504, L-29598, L-30620, L-32884, L-42021, L-44054, L-48788, L-76965, L-80894, N-16400, N-64545
SMOKING A-00375, A-69039, G-08702, G-38721, G-39494, G-43636, G-84137
SNOW A-44566, C-18344, C-48392, C-51599, D-33309, H-16567, H-36998, N-04212
SOAP AND DETERGENT PLANTS A-40344, A-45858, A-47963
SOAP MANUFACTURING A-40344, A-45858
SOCIAL ATTITUDES B-09664, M-68522, N-28923, N-49170
SOCIO-ECONOMIC FACTORS A-45145, B-09664, B-25178, B-36405, B-47731, B-52094, G-34398, G-84137, H-13474, H-48022, H-49647, H-70984, J-30226, J-30696, J-60298, K-71991, L-42810, L-77234, N-49170, N-66750
SODIUM CARBONATE B-30276, B-38188, B-38504, B-48480, C-13056, C-48674, D-39182, H-16150
SODIUM CHLORIDE A-09799, C-24022, C-43234, C-80103, G-03394, G-10362, H-16150, H-39902, L-29818
SODIUM COMPOUNDS A-04068, A-09799, A-18449, A-27617, A-33853, A-43403, A-51100, A-52741, A-64926, A-79567, A-80994, B-18536, B-24117, B-30276, B-30814, B-31708, B-32384, B-37509, B-38188, B-38439, B-38445, B-38504, B-38593, B-45757, B-48480, B-48879, B-56064, B-60075, B-60255, B-64898, B-75387, B-77838, C-00264, C-04463, C-04687, C-04692, C-07860, C-09770, C-10632, C-13056, C-24022, C-24114, C-24124, C-24310, C-24966, C-26729, C-29738, C-29887, C-43234, C-44083, C-48674, C-61859, C-75339, C-80103, C-83442, D-33017, D-39182, E-40271, E-43424, F-04468, F-13998, G-03246, G-03394, G-04927, G-06485, G-10362, G-16874, G-23563, G-26846, G-32152, G-32605, G-32606, G-39799, G-39810, G-39813, G-41686, G-54968, H-00137, H-00631, H-02382, H-03360, H-03860, H-03873, H-04672, H-04683, H-04997, H-06342, H-06354, H-06681, H-13474, H-16150, H-18269, H-18271, H-24282, H-24548, H-24787, H-27907, H-35992, H-37346, H-38407, H-39902, H-42958, H-43622, H-47806, H-60961, H-63442, H-80067, H-83721, L-20273, L-29818
SODIUM HYDROXIDE B-30814, B-38439, B-38504, B-48480, B-48879, B-56064, B-64898, C-24966
SODIUM PROCESSES B-78814
SODIUM SULFITE A-33853, B-60255, H-83721
SOILING A-34018, A-60281, I-07553, I-27060, K-07605
SOILING INDEX C-50922, D-50307, D-63526, L-47380
SOILS A-11453, A-37190, A-48048, A-68912, A-74512, A-83543, B-64428, C-25617, C-38670, C-39136, C-44710, C-57781, D-31371, D-56465, D-71348, G-11945, G-43323, G-48697, G-67325, G-71933, H-05724, H-06353, H-11157, H-14678, H-19604, H-19873, H-22624, H-23579, H-23950, H-24282, H-24358, H-24366, H-24548, H-24787, H-24933, H-26092, H-26795, H-28647, H-29206, H-32289, H-32736, H-32771, H-36742, H-36996, H-36998, H-37403, H-37567, H-38404, H-38412, H-38417, H-38568, H-39183, H-40202, H-40472, H-41189, H-41696, H-41904, H-42086, H-42923, H-42958, H-43492, H-43493, H-44295, H-44428, H-45007, H-45467, H-45776, H-46217, H-47286, H-48022, H-48374, H-48941, H-49647, H-50503, H-50505, H-50959, H-51526, H-52651, H-52705, H-56428, H-56963, H-61496, H-64427, H-65179, H-71098, H-80085, H-81288, H-82498, H-84484, J-38409, L-28349, L-29421, L-37943
SOLAR RADIATION A-23561, A-80507, B-45468, C-48392, E-72995, F-44721, F-62189, G-18987, G-19148, G-38616, G-49756, H-00301, H-19539, H-31527, H-32714, H-40202, H-41189, H-47014, H-48798, H-64427, I-27060, I-46606, N-66750
SOLID WASTE FUELS B-80950, B-82446
SOLVENTS A-09785, A-30517, A-37996, A-40344, A-44566, A-47143, A-79280, B-32190, B-36532, B-37536, B-45707, B-47125, B-49023, B-70428, C-45802, D-49860, F-13998, G-57701, I-40510, L-09677, L-32173, L-32245, L-80894
SOOT A-11453, A-20134, A-29519, A-29786, A-36377, A-39460, A-40344, A-44566, A-46925, A-49617, A-49852, A-49924, A-59494, A-72133, A-77522, B-38593, B-45707, B-65640, B-66624, B-71796, B-72139, B-82446, C-09983, C-35108, C-41763, C-48392, C-49752, C-84660, D-17102, D-33108, D-34008, E-33579, F-59528, G-18987, G-31319, G-39494, G-41706, G-43323, G-43636, G-50318, G-60625, H-03116, H-11157, H-19604, H-30225, H-38332, H-39190, H-39466, H-42601, H-47014, H-47286, H-52928, H-69800, J-48171, K-27010, K-28466, K-34063, K-38197, K-41682, K-72151, K-80854, L-28349, L-29421, L-29504, L-30620, L-32789, L-35795, L-37943, L-38669, L-39306, L-42021, L-52026, L-76847, L-77234, N-04212, N-16400, N-21287, N-65407
SOOT FALL C-24603, D-37502, G-18785, L-17614
SORGHUM H-81495
SOURCE MONITORING A-02847, A-03565, A-05040, A-05139, A-05140, A-05587, A-08102, A-08116, A-08748, A-09214, A-09321, A-09332, A-09651, A-09690, A-09692, A-09693, A-09694, A-09695, A-09696, A-09697, A-11341, A-11541, A-11590, A-11876, A-12470, A-12474, A-12587, A-12676, A-12740, A-12741, A-12747, A-12749, A-12750, A-12773, A-12809, A-12813, A-12822, A-12828, A-12884, A-12886, A-12888, A-12889, A-12919, A-12929, A-12931, A-12933, A-22875, A-30218, A-31144, A-31529, A-40600, A-42751, A-59921, A-60283, A-65064, A-67748, A-67834, A-68823, A-69353, A-70069, A-70727, A-75206, A-76152, A-79043, A-81861, A-81916, A-81917, A-81931, A-81935, B-43533, B-59459, B-70428, B-75204, B-77816, C-05317, C-06397, C-20650, C-22877, C-23575, C-25647, C-29198, C-29737, C-29738, C-30958, C-35108, C-35737, C-35956, C-37579, C-38670, C-41624, C-44238, C-46034, C-50337, C-52206, C-52992, C-53876, C-53987, C-55367, C-59513, C-59814, C-63848, C-68086, C-69765, C-70638, C-73127, C-74221, C-75058, C-81439, C-83442, D-37994, E-59075, J-39910, K-81864, L-24381
SOUTH AFRICA N-66750
SOUTH DAKOTA H-68502
SOUTH PACIFIC A-49886, A-55407, B-17485, B-21034, B-29403, B-41418, B-76232, B-80950, C-09560, E-79132, H-76233, L-44598
SOX CONTROL A-00896, A-15452, A-18323, A-22875, A-32519, A-34096, A-34334, A-38657, A-42675, A-43014, A-46925, A-47188, A-47962, A-47965, A-47966, A-55212, A-57231, A-60727, A-60728, A-60866, A-63661, B-12288, B-15322, B-16555, B-17463, B-18641, B-18826, B-18830, B-20436, B-22943, B-23182, B-24033, B-24333, B-25038, B-25178, B-25638, B-26908, B-27282, B-28709, B-28889, B-29680, B-29725, B-30276, B-30519, B-30814, B-31889, B-33620, B-33918, B-35106, B-35111, B-35513, B-36725, B-37603, B-38299, B-38476, B-40381, B-40712, B-41378, B-42083, B-42104, B-43108, B-44716, B-44793, B-44838, B-45707, B-45846, B-47054, B-47086, B-47256, B-47341, B-47731, B-48480, B-48805, B-48811, B-48879, B-50937, B-51101, B-51845, B-52445, B-53603, B-53620, B-53868, B-54799, B-56057, B-56591, B-59679, B-60075, B-60255, B-60849, B-60864, B-61935, B-63474, B-64977, B-65640, B-67700, B-68795, B-69965, B-71472, B-72656, B-74480, B-74483, B-75387, B-78814, B-79079, B-80500, B-81256, B-81334, B-83198, C-00126, C-21806, C-22877, C-23575, C-29426, C-55858, C-61103, C-66753, D-35764, D-47976, D-49860, E-14897, F-44721, H-39537, H-41696, H-69966, J-29923, L-24122, L-39306, L-42873, N-50867, N-64545, N-64937
SOYBEANS A-31144, H-00788, H-00920, H-05398, H-05399, H-12032, H-15404, H-20708, H-21500, H-31124, H-34880, H-39363, H-42601, H-42907, H-56213, H-70607, H-79972, H-81495
SPACECRAFT ATMOSPHERES B-12465
SPAIN G-84137
SPARK IGNITION ENGINES A-49924, B-07549
SPECIFIC ION ELECTRODE C-79032, C-79389, C-84499, H-79368, H-79973
SPECTROMETRY A-48116, A-48572, A-49738, A-50013, A-53955, A-75077, C-02681, C-09560, C-20650, C-22812, C-22877, C-23907, C-24603, C-26209, C-26729, C-27248, C-29198, C-31115, C-31827, C-32476, C-32534, C-35108, C-35956, C-39022, C-39136, C-39719, C-41063, C-41489, C-42375, C-43979, C-43985, C-43986, C-45802, C-46034, C-47096, C-48315, C-48492, C-49391, C-49509, C-49752, C-49879, C-49992, C-50093, C-50337, C-50470, C-31762, C-53523, C-58278, C-61859, C-61957,

C-63848, C-64779, C-67116, C-69174, C-69765, C-71044, C-74942, C-75058, C-75339, C-79032, C-79835, C-79843, C-80227, C-80259, C-80495, C-82552, C-82650, C-83442, C-83495, C-83592, D-52578, E-04987, E-43424, E-43855, F-02517, F-04468, F-04674, F-32952, F-41543, F-62189, F-80516, F-81496, G-01096, H-00964, H-02516, H-07255, H-12032, H-50503, I-00085, K-08420, L-17472

SPECTROPHOTOMETRY A-31529, A-41877, A-42731, A-48116, A-75077, B-29680, C-00264, C-02681, C-03478, C-05914, C-06397, C-07871, C-09560, C-11574, C-12451, C-15171, C-16801, C-16969, C-20540, C-20595, C-20778, C-22312, C-22877, C-22879, C-23286, C-23517, C-23518, C-23546, C-23569, C-23573, C-23654, C-24008, C-24022, C-24050, C-24124, C-24222, C-24456, C-25487, C-25668, C-25816, C-25952, C-26122, C-26259, C-26485, C-26707, C-26744, C-27131, C-27294, C-27927, C-28126, C-28285, C-28441, C-28462, C-30014, C-30958, C-31115, C-31827, C-34126, C-35956, C-38670, C-39008, C-39719, C-40138, C-40705, C-41624, C-43985, C-47096, C-47193, C-48392, C-48916, C-49752, C-49879, C-50936, C-51762, C-52101, C-53523, C-55789, C-61957, C-64779, C-66753, C-67116, C-69174, C-71232, C-74221, C-74346, C-74942, C-75339, C-79389, C-82650, D-28097, D-39182, D-48850, D-52578, E-04987, F-02517, G-01096, G-04734, G-08030, G-23563, G-27755, G-31234, H-00788, H-18319, H-21498, H-32854, H-39902, H-40368, K-08420

SPINACH B-02541, H-00187, H-01800, H-28437, H-28483, H-30142, H-31208, H-36994, H-41699, H-45007, H-84553

SPORES D-19966, D-29040, G-01794, G-07098, G-61467, H-33127, H-62275

SPOT TESTS C-00260, C-43234, C-43981, C-48315, E-04987, H-00187, H-48556

SPRAY TOWERS A-05090, A-05601, A-09651, A-11341, A-12476, A-12622, A-12676, B-02962, B-06587, B-08344, B-15372, B-15813, B-18699, B-22484, B-22913, B-24116, B-24834, B-26401, B-28786, B-29680, B-36532, B-37544, B-38587, B-40712, B-42104, B-43533, B-45078, B-47054, B-47341, B-49023, B-50652, B-52838, B-55524, B-60075, B-61741, B-64898, B-71472, B-73175, B-76512, B-80356, B-81772, B-81773, B-84418, G-40527, L-24481, L-33722

SPRAYS B-38874, B-70840, H-03860

SPUTUM G-83798

ST LOUIS A-00640, C-00260, C-00626, C-01349, C-02565, D-24736, D-52578, F-01677, G-01096, G-04145, H-00265, H-00266, H-01705, I-00085, I-00695, L-09677

STABILITY (ATMOSPHERIC) A-07650, A-09785, A-31333, A-32702, A-44566, A-48048, B-25195, D-09590, D-26086, D-33309, D-33858, D-39182, D-40896, D-48791, D-58218, E-05054, E-14897, E-59234, G-18785, G-18988, G-30788, G-36751, G-40597, G-44867, G-49756, H-36996, H-38412, H-57810, H-78580, I-07553, L-82278, N-49170, N-69692

STACK GASES A-00896, A-01125, A-01528, A-02847, A-03565, A-04068, A-05139, A-05140, A-05587, A-05871, A-08102, A-08116, A-08748, A-09214, A-09321, A-09332, A-09541, A-09651, A-09690, A-09692, A-09693, A-09694, A-09695, A-09696, A-09697, A-09799, A-11341, A-11590, A-11876, A-11877, A-12470, A-12474, A-12587, A-12622, A-12676, A-12692, A-12740, A-12747, A-12750, A-12773, A-12809, A-12822, A-12828, A-12884, A-12886, A-12888, A-12889, A-12919, A-12929, A-12931, A-12933, A-15452, A-17344, A-22875, A-23022, A-24039, A-26329, A-28652, A-29519, A-30218, A-30517, A-31144, A-31315, A-31529, A-32519, A-33735, A-33853, A-34334, A-35985, A-37190, A-37562, A-40344, A-40401, A-42675, A-42676, A-42677, A-42680, A-42682, A-42683, A-43816, A-45858, A-46925, A-47945, A-47962, A-47966, A-49886, A-50018, A-52277, A-52508, A-52912, A-53295, A-54622, A-55407, A-57231, A-58334, A-58370, A-58402, A-58939, A-59494, A-60281, A-60727, A-60728, A-60866, A-61154, A-61183, A-61570, A-63661, A-65064, A-67748, A-67834, A-68703, A-68823, A-69309, A-69422, A-70069, A-70727, A-71615, A-72125, A-74154, A-75089, A-76274, A-76644, A-77367, A-77522, A-79043, A-80994, A-81861, A-81917, A-81935, A-82192, B-04794, B-07664, B-08344, B-10618, B-15322, B-16555, B-17463, B-17485, B-18641, B-18698, B-18699, B-18826, B-18830, B-19177, B-21034, B-22040, B-22484, B-22598, B-22943, B-23182, B-24110, B-24333, B-24355, B-24834, B-25195, B-25433, B-25658, B-26317, B-26401, B-27569, B-28709, B-29403, B-29680, B-30276, B-30519, B-30814, B-31567, B-31708, B-31889, B-32232, B-32384, B-32461, B-32627, B-32712, B-32963, B-33918, B-35106, B-35111, B-36716, B-37402, B-37544, B-37603, B-37809, B-38082, B-38115, B-38439, B-38476, B-38504, B-38587, B-38593, B-40251, B-40381, B-40712, B-40892, B-41378, B-42078, B-42083, B-42104, B-42172, B-42287, B-43108, B-43481, B-43533, B-44121, B-44716, B-45078, B-45254, B-45846, B-47054, B-47086, B-47095, B-47125, B-47186, B-47256, B-47341, B-47463, B-47466, B-47821, B-48143, B-48805, B-48811, B-48814, B-48879, B-49031, B-49420, B-49477, B-49979, B-50154, B-50652, B-51101, B-51720, B-51755, B-51845, B-52179, B-52445, B-52838, B-52852, B-53620, B-53867, B-53868, B-54310, B-54799, B-55678, B-56057, B-56078, B-56528, B-56531, B-56591, B-58380, B-58466, B-58632, B-58879, B-58993, B-59230, B-59679, B-59845, B-59861, B-60075, B-60206, B-60255, B-60849, B-61239, B-61273, B-61741, B-61935, B-62165, B-62786, B-63474, B-63540, B-63775, B-63784, B-64070, B-64092, B-64428, B-64506, B-64696, B-64898, B-64977, B-65640, B-66592, B-66624, B-66947, B-67136, B-67237, B-67217, B-67700, B-68633, B-68795, B-69131, B-69528, B-69965, B-70428, B-70537, B-70658, B-70659, B-70840, B-71297, B-71472, B-71623, B-71796, B-71841, B-72038, B-72656, B-73031, B-73175, B-74480, B-74483, B-75387, B-77475, B-77816, B-78814, B-78890, B-79079, B-79657, B-80500, B-81256, B-81645, B-81772, B-81773, B-83198, B-83667, C-03119, C-06112, C-06397, C-18230, C-22812, C-22877, C-23575, C-25223, C-26713, C-29737, C-30793, C-30958, C-31115, C-32631, C-33632, C-35108, C-35737, C-35956, C-37463, C-37579, C-38670, C-39136, C-41624, C-43570, C-44238, C-49391, C-49476, C-52992, C-53876, C-55367, C-55858, C-59049, C-59513, C-60278, C-60553, C-60951, C-61103, C-61896, C-67528, C-68086, C-69174, C-70638, C-70686, C-72015, C-73349, C-74221, C-75058, C-76212, C-79842, C-82650, C-84182, D-23760, D-25093, D-26702, D-33858, D-37502, D-41979, D-56463, D-77485, D-77512, E-14897, E-29774, E-33579, E-37639, E-44277, E-59075, E-59234, E-78943, F-44721, G-18785, G-31319, G-32601, G-32607, G-33510, G-33511, G-39219, G-40527, G-40597, G-40635, G-44597, G-67325, G-67440, G-74369, H-08884, H-11452, H-18226, H-21189, H-21422, H-23214, H-23295, H-23386, H-23950, H-24024, H-24064, H-24395, H-25865, H-26734, H-28647, H-29736, H-31733, H-32535, H-32539, H-32714, H-36787, H-37480, H-38017, H-38404, H-38412, H-38417, H-38574, H-39493, H-39537, H-39684, H-41370, H-41696, H-41698, H-42601, H-42857, H-43492, H-44295, H-45160, H-46198, H-47385, H-51109, H-51321, H-56874, H-57475, H-58777, H-59327, H-59935, H-60690, H-60913, H-65179, H-67453, H-69596, H-74588, H-74624, H-76233, H-77377, H-77391, H-81288, I-58585, I-65935, J-38409, J-39910, J-41121, K-34063, K-36823, K-37472, K-58899, K-66860, K-68[illegible], K-68582, K-78880, L-09677, L-17185, L-19064, L-19434, L-20273, L-24481, L-29421, L-30620, L-33722, L-38573, L-38669, L-39306, L-39749, L-48719, L-59722, L-64940, N-63776, N-64545, N-64937, N-65407

STACK HEIGHT B-77816, B-81772

STACK MONITORING A-02847, A-03565, A-05040, A-05139, A-05140, A-05587, A-08102, A-08116, A-09214, A-09321, A-09332, A-09651, A-09690, A-09692, A-09693, A-09694, A-09695, A-09696, A-09697, A-11341, A-11541, A-11590, A-12470, A-12474, A-12587, A-12676, A-12740, A-12741, A-12747, A-12749, A-12750, A-12773, A-12809, A-12813, A-12822, A-12828, A-12884, A-12886, A-12888, A-12889, A-12919, A-12929, A-12931, A-12933, A-22875, A-31529, A-42751, A-63064, A-69353, A-70069, A-79043, B-43533, B-70428, C-05317, C-06397, C-20650, C-22877, C-23575, C-25647, C-29198, C-29737, C-30958, C-35737, C-35956, C-37579, C-38670, C-41624, C-44238, C-52206, C-52992, C-53987, C-59513, C-63848, C-68086, C-70638, C-75058, C-81439, E-59075, L-24481

STACKS A-09214, A-17377, A-24039, A-26329, A-34096, A-36212, A-40344, A-44566, A-45858, A-47061, A-60827, A-68703, B-19177, B-25195, B-25638, B-27569, B-29680, B-35106, B-37402, B-38082, B-44121, B-49031, B-49979, B-50154, B-65640, B-70428, B-70840,

B-77816, B-81772, C-06112, C-06397, C-10966, C-22877, C-35956, C-44238, D-35764, D-42760, D-47976, H-00301, H-17620, H-18226, H-38412, H-39537, H-41370, H-41696, H-41698, I-39031, K-37472, K-44377, K-47672, L-17614, L-29504, L-29598, L-39306, L-42873, L-67888, N-46820, N-63776, N-64937, N-69692
STAGNATION D-09590, D-38218, H-36996

STANDARD GASES E-77970
STATE GOVERNMENTS A-03450, B-24683, B-25638, D-25593, K-08420, K-19750, K-47672, L-06349, L-06938, L-06939, L-09677, L-19064, L-19434, L-24481, L-32354, L-33495, L-48788, L-59722, L-76847, L-76965, N-32254
STATISTICAL ANALYSES A-11916, A-23865, A-40344, A-42685, C-05586, C-06338, C-24279, C-25474, C-26909, C-60410, C-73349, D-33858, F-15927, G-18988, G-23003, H-04848, H-05612, H-09553, H-25230, H-48941, H-51754, H-58777, H-70745, J-28805, J-30696, J-32706, N-66750
STEAM B-38115, B-42078, B-49031, B-65638, B-71297, C-19076, C-24114, C-44552, H-54066
STEAM ELECTRIC POWER GENERATION A-09785, A-17464, A-24039, A-29519, A-47410, A-47966, A-61007, A-67940, A-68703, A-69422, A-80334, A-80507, A-81343, A-81917, A-81931, A-81935, B-10618, B-24683, B-25038, B-40381, B-41378, B-45078, B-65638, B-67700, B-80500, C-44238, D-09590, D-33309, F-44721, H-69596, H-70487, I-56143, K-37472, L-17472, L-29421, L-29598
STEAM ENGINES B-75138
STEEL A-17471, A-26136, A-30296, A-31935, A-35592, A-39460, A-40159, A-40182, A-41877, A-42682, A-45858, A-47962, A-49617, A-49924, A-52912, A-60866, A-61564, A-67806, A-69039, B-04794, B-05567, B-06587, B-07664, B-08344, B-10618, B-19210, B-23182, B-32627, B-33918, B-40892, B-43108, B-47677, B-58380, C-49391, C-53625, C-58842, C-60951, C-68086, D-09590, D-09658, D-39737, D-49260, D-49860, D-63526, G-01096, G-28556, G-48697, G-66044, H-32282, H-38568, H-50959, H-65715, I-00085, I-07553, I-39031, I-40510, I-40833, I-46606, I-54961, I-63871, J-29923, J-30696, J-39910, J-48171, L-29598, L-39749, L-59722, N-21287
STILBENE C-17128
STIPPLING H-01250, H-01800, H-14968, H-21364, H-44595, H-51109, H-56625, H-57810, H-78580
STOMACH G-04983, G-37795, H-48193
STOMATA H-79972, H-80085
STONE A-39460, A-42677, A-43272, A-47965, A-60729, B-64428, I-07553, I-24308, I-46606, I-52320, I-56143, I-73616, L-37747
STONE, CLAY, GLASS, AND CONCRETE PRODUCT A-79280, A-79774, A-81745, B-77816, B-79079, C-82650, C-84463, D-83399, H-80079, H-80575, L-77817
STREETS A-36377, D-18537, D-22348, H-40368, H-41904, H-48941, H-54597, H-56637, L-29421, L-29598
STRONTIUM COMPOUNDS A-51100, A-60729, A-75077, A-76638, A-81343, C-09770, C-61859, C-75339, D-33017, H-47806
STRUCTURES A-31134, B-04853, C-01349, C-20701, C-27330, C-28251, D-09590, E-37639, E-44030, F-04763, G-01674, H-00187, H-00265, H-00301, H-00979, H-01705, H-05324, H-06413, H-07255, H-16222, H-18770, H-20917, H-26711, H-28802, H-30298, H-30299, H-35880, H-44345, H-77325, I-73616
STUDENTS G-30183, G-32152
STYRENES A-48572, A-72133, K-51057
SULFATES A-00375, A-01125, A-09785, A-27617, A-33853, A-37752, A-39460, A-43403, A-69353, A-71262, A-75089, A-81931, B-02541, B-36475, B-38188, B-45757, B-49023, B-55180, B-60255, C-01593, C-04463, C-07860, C-09560, C-22458, C-23096, C-24018, C-24279, C-26485, C-26729, C-38280, C-43234, C-43985, C-44174, C-45802, C-49752, C-49992, C-74354, C-80103, D-21419, D-27254, D-37994, D-39182, D-43170, D-50307, D-50550, D-51929, D-55187, D-58218, E-40271, E-49185, G-11000, G-33276, G-73658, H-13474, H-16150, H-23295, H-28474, H-35880, H-36742, H-39098, H-41699, H-45007, H-45467, H-54527, H-60760, K-08420, K-19750, K-47672, K-51212, K-51229, L-06734, L-25542
SULFATION-OF-LEAD METHODS C-11574, C-12451, C-22517, C-24603, C-29771, C-35108, C-39022, C-47218, C-49879, D-09590, D-09658, D-23392, D-26026, D-33309, D-37502, D-39054, D-44267, D-48850, D-49118, I-00695
SULFIDES A-00220, A-08382, A-09785, A-17344, A-18449, A-20134, A-23561, A-23865, A-26254, A-31315, A-32060, A-32702, A-32855, A-34018, A-36045, A-36377, A-38657, A-39460, A-39862, A-40344, A-40471, A-40600, A-42682, A-43270, A-44566, A-45145, A-46925, A-47143, A-47962, A-49617, A-49738, A-49852, A-49924, A-50938, A-53751, A-60281, A-60866, A-66977, A-67806, A-71262, A-80238, B-02541, B-07549, B-08344, B-15322, B-22943, B-24033, B-26908, B-29403, B-29680, B-30519, B-31889, B-32190, B-35106, B-36532, B-41378, B-42078, B-43299, B-44793, B-45707, B-45846, B-47054, B-47680, B-48480, B-49031, B-60864, B-61741, B-62165, B-63474, B-64898, B-68633, B-79711, C-02681, C-03527, C-05586, C-05914, C-06112, C-09983, C-11574, C-15171, C-16109, C-17092, C-20030, C-20595, C-20650, C-22517, C-22812, C-22877, C-23096, C-24603, C-25223, C-26122, C-27044, C-28126, C-29771, C-30793, C-30840, C-31115, C-31712, C-32476, C-32534, C-32643, C-35108, C-35441, C-35737, C-35956, C-38280, C-38670, C-39719, C-39871, C-40422, C-41763, C-42926, C-42928, C-43981, C-43985, C-43986, C-44253, C-44933, C-45760, C-46034, C-46303, C-47218, C-48392, C-48492, C-50337, C-50922, C-51762, C-58278, C-59814, C-60553, C-61103, C-61993, C-65118, C-65846, C-66606, C-68944, C-69174, C-74471, C-74942, C-79842, C-80103, C-80573, C-83592, C-84471, C-84660, D-09590, D-09658, D-18537, D-25393, D-26086, D-26702, D-31371, D-31396, D-32679, D-33108, D-33425, D-34008, D-39737, D-41979, D-44799, D-49860, E-04987, E-29774, E-40271, F-16218, F-31948, F-52013, F-68048, G-00165, G-01794, G-02539, G-03394, G-04734, G-07098, G-18988, G-19148, G-24153, G-28199, G-34398, G-36751, G-38616, G-43323, G-44867, G-46085, G-48068, G-68583, G-71536, G-79848, G-80857, G-84260, H-00301, H-03395, H-04984, H-08884, H-12042, H-12155, H-13474, H-17710, H-20158, H-23188, H-23295, H-23516, H-28475, H-29597, H-30473, H-32982, H-35613, H-36742, H-39537, H-40202, H-41362, H-41696, H-41699, H-41983, H-42923, H-45345, H-47014, H-49778, H-49779, H-51526, H-52928, H-67457, I-00695, I-07553, I-23108, I-27060, I-46606, I-58585, I-69995, K-03582, K-08420, K-10168, K-11414, K-19750, K-19818, K-27010, K-28466, K-37472, K-44310, K-47672, K-51057, K-51212, K-51229, K-68582, K-72151, L-06349, L-06734, L-06754, L-17188, L-17472, L-17614, L-29504, L-29818, L-33722, L-40461, L-40889, L-41455, L-44054, L-47380, L-48719, L-50180, L-73839, N-04212, N-46820, N-49170, N-64937, N-65407
SULFIDINE PROCESS N-66750
SULFITES B-30814, B-61954, C-45802, C-71044, H-28474
SULFONIC ACID L-29504
SULFUR COMPOUNDS A-00220, A-00375, A-00896, A-01125, A-08882, A-09785, A-11453, A-17344, A-17377, A-18323, A-18449, A-20134, A-23561, A-23865, A-26254, A-27617, A-28038, A-31315, A-32060, A-32139, A-32702, A-32855, A-33853, A-34018, A-36045, A-36377, A-37752, A-38657, A-39460, A-39862, A-40344, A-40471, A-40600, A-41877, A-42682, A-43270, A-43403, A-44566, A-45145, A-46925, A-47143, A-47962, A-49617, A-49738, A-49852, A-49924, A-50938, A-51102, A-52741, A-53751, A-59257, A-60281, A-60866, A-66977, A-67806, A-69353, A-71262, A-75089, A-79774, A-80238, A-80994, A-81931, B-02541, B-07549, B-08344, B-15322, B-22943, B-24033, B-24333, B-24683, B-25178, B-26908, B-29403, B-29680, B-30519, B-30814, B-31889, B-32190, B-35106, B-36475, B-36532, B-38188, B-41378, B-42078, B-43299, B-44793, B-45707, B-45757, B-45846, B-47054, B-47677, B-47680, B-48480, B-49023, B-49031, B-55180, B-60255, B-60849, B-60864, B-61741, B-61954, B-62165, B-63474, B-64898, B-65640, B-67700, B-68633, B-79711, B-80950, C-01593, C-02681, C-03527, C-04463, C-05586, C-05914, C-06112, C-07860, C-09560, C-09770, C-09983, C-11574, C-15171, C-16109, C-17092, C-17117, C-20030, C-20595, C-20650, C-22458, C-22517, C-22812, C-22877, C-23096, C-23517, C-24018, C-24279, C-24603, C-25223, C-26122, C-26203, C-26485, C-26729, C-27044, C-27248, C-28126, C-29771, C-30007, C-30793, C-30840, C-31115, C-31712, C-32476, C-32534, C-32643, C-35108, C-35441, C-35737, C-35956, C-38280, C-38670, C-39136, C-39719, C-39762, C-39871, C-40422,

C-41763, C-42375, C-42926, C-42928, C-43234, C-43981, C-43985, C-43986, C-44174, C-44253, C-44933, C-45760, C-45802, C-46034, C-46303, C-47218, C-48392, C-48492, C-49752, C-49992, C-50337, C-50876, C-50922, C-51762, C-52629, C-58278, C-59814, C-60553, C-61103, C-61692, C-61851, C-61993, C-65118, C-65846, C-66606, C-68944, C-69174, C-71044, C-72017, C-74354, C-74471, C-74942, C-79842, C-80103, C-80227, C-80573, C-83442, C-83592, C-84471, C-84660, D-09590, D-09658, D-18537, D-21419, D-23760, D-25593, D-26086, D-26702, D-27254, D-31371, D-31396, D-32679, D-33017, D-33080, D-33108, D-33425, D-34008, D-37994, D-39182, D-39737, D-40896, D-41979, D-43170, D-44799, D-49860, D-50307, D-50550, D-51929, D-52578, D-55187, D-56464, D-56792, D-58218, E-04987, E-29023, E-29774, E-33579, E-40271, E-49185, F-13565, F-16218, F-32952, F-34948, F-52013, F-68048, F-78035, G-00165, G-01794, G-02539, G-03394, G-04734, G-07098, G-11000, G-18988, G-19148, G-24153, G-28199, G-33276, G-34398, G-36751, G-38616, G-43323, G-44867, G-46085, G-48068, G-48597, G-68583, G-71536, G-73658, G-79848, G-80197, G-80857, G-84260, H-00301, H-03395, H-04984, H-08884, H-12042, H-12155, H-13474, H-16150, H-17710, H-20158, H-23188, H-23214, H-23295, H-23516, H-25366, H-28474, H-28475, H-29597, H-30473, H-32982, H-35613, H-35880, H-36742, H-39098, H-39328, H-39537, H-40202, H-41362, H-41696, H-41699, H-41983, H-42923, H-43492, H-45007, H-45160, H-45345, H-45467, H-47014, H-48413, H-49778, H-49779, H-50959, H-51526, H-51754, H-52102, H-52928, H-54297, H-54597, H-59327, H-60760, H-65179, H-67457, H-70279, H-71078, H-77325, H-77329, H-82498, H-84290, H-84484, I-00695, I-07553, I-08076, I-23108, I-27060, I-40833, I-46606, I-54961, I-58585, I-69995, J-29923, K-03582, K-08420, K-10168, K-11414, K-19750, K-19818, K-27010, K-28466, K-33107, K-37472, K-41682, K-44310, K-47672, K-51057, K-51212, K-51229, K-68582, K-72151, L-06349, L-06734, L-06754, L-09677, L-17188, L-17472, L-17614, L-25542, L-29504, L-29818, L-33722, L-40461, L-40889, L-41455, L-44054, L-47380, L-48719, L-50180, L-60630, L-73839, L-77234, L-83965, N-04212, N-46820, N-49170, N-63463, N-64937, N-65407

SULFUR DIOXIDE A-00220, A-00375, A-00896, A-01125, A-01528, A-01687, A-02019, A-02312, A-04068, A-07650, A-08748, A-08882, A-09651, A-09693, A-09785, A-11341, A-11453, A-11590, A-11876, A-11877, A-12470, A-12474, A-12557, A-12773, A-12889, A-17076, A-17344, A-17357, A-17464, A-17471, A-18323, A-20134, A-22973, A-23561, A-23865, A-24039, A-24370, A-27314, A-28282, A-29519, A-29532, A-29786, A-30218, A-30447, A-30517, A-31315, A-31333, A-31529, A-32519, A-32702, A-32855, A-33853, A-34096, A-35985, A-36045, A-36212, A-36377, A-37190, A-37752, A-37996, A-38657, A-39587, A-39862, A-40159, A-40182, A-40344, A-40401, A-40471, A-41650, A-42675, A-42676, A-42680, A-42682, A-42685, A-44566, A-46119, A-46558, A-46925, A-47410, A-47945, A-47959, A-47962, A-47963, A-47965, A-47966, A-48231, A-48849, A-48946, A-49852, A-49924, A-50381, A-50938, A-51100, A-52508, A-52664, A-54622, A-55212, A-59775, A-59921, A-60283, A-60728, A-60827, A-60866, A-61007, A-61154, A-61183, A-66977, A-67806, A-67940, A-68703, A-69309, A-69353, A-69422, A-71273, A-72079, A-74262, A-75089, A-79043, A-79567, A-79774, A-80334, A-81861, A-81916, A-81931, A-81935, A-82192, B-05567, B-07549, B-07552, B-08344, B-10618, B-12465, B-14692, B-15322, B-16962, B-18641, B-18698, B-18826, B-19177, B-19571, B-21795, B-25590, B-26908, B-26911, B-27569, B-28502, B-29403, B-29680, B-30519, B-32190, B-32231, B-33554, B-33918, B-33971, B-35106, B-35513, B-36405, B-36475, B-37536, B-37809, B-38115, B-38476, B-38504, B-38593, B-40892, B-41378, B-41569, B-42991, B-43299, B-44838, B-44979, B-45380, B-45468, B-45544, B-45707, B-45846, B-47086, B-47341, B-47680, B-47731, B-47821, B-48805, B-48811, B-48879, B-49023, B-49031, B-49477, B-49929, B-49979, B-50154, B-50435, B-50937, B-51101, B-53603, B-55678, B-59845, B-60849, B-60864, B-61259, B-61741, B-62165, B-64696, B-64898, B-67742, B-67954, B-68633, B-68795, B-69131, B-70428, B-71412, B-71796, B-71841, B-73031, B-74480, B-75204, B-75387, B-76512, B-78245, B-78890, B-79711, B-81772, B-81773, B-82446, B-83134, B-83667, C-00126, C-01593, C-02681, C-03119, C-03527, C-05078, C-05586, C-06962, C-09983, C-10632, C-11574, C-17092, C-20030, C-20595, C-20650, C-22812, C-22877, C-22879, C-23162, C-23907, C-24399, C-24603, C-24970, C-25223, C-26121, C-26707, C-26713, C-26729, C-27044, C-27294, C-28102, C-28126, C-28671, C-29198, C-29771, C-30014, C-30840, C-31115, C-32476, C-32643, C-35108, C-35737, C-36800, C-38280, C-38670, C-39022, C-39136, C-39719, C-39762, C-39871, C-42926, C-42928, C-43672, C-43979, C-43981, C-43985, C-43986, C-44238, C-44253, C-44285, C-45760, C-46034, C-46303, C-48392, C-48492, C-49391, C-49879, C-49992, C-50337, C-51762, C-52992, C-56572, C-56865, C-58278, C-59814, C-60553, C-61103, C-61993, C-63848, C-65118, C-65846, C-66606, C-66753, C-67116, C-68944, C-70686, C-71044, C-72017, C-73127, C-74221, C-74346, C-74354, C-75058, C-79032, C-79842, C-79843, C-80103, C-80259, C-80573, C-83592, C-84660, D-09590, D-09658, D-17102, D-17642, D-19145, D-19966, D-21419, D-22348, D-22359, D-23392, D-23760, D-23845, D-25593, D-26026, D-26086, D-26702, D-27254, D-30705, D-31371, D-31396, D-32666, D-32679, D-33108, D-33309, D-33425, D-34008, D-36806, D-37502, D-37607, D-37994, D-39737, D-40896, D-41979, D-42760, D-43170, D-44799, D-49860, D-50307, D-50550, D-50690, D-56463, D-56792, D-60574, D-63186, D-63526, D-67690, D-70500, D-73286, D-74121, D-78193, D-78442, D-84625, E-04987, E-14897, E-29315, E-29774, E-33579, E-37037, E-49185, E-59234, E-78943, E-79132, F-16218, F-52013, F-53153, F-55415, F-57580, F-57581, F-80516, F-81496, G-01794, G-03394, G-05504, G-05833, G-06675, G-07098, G-07961, G-11467, G-11942, G-16345, G-18785, G-18987, G-18988, G-24153, G-24392, G-24580, G-26274, G-28199, G-30788, G-31319, G-32607, G-33509, G-33510, G-33511, G-34398, G-38616, G-38721, G-40597, G-41684, G-41706, G-43277, G-43323, G-43636, G-48068, G-49756, G-50318, G-55517, G-57299, G-60625, G-61146, G-61467, G-66044, G-67440, G-71536, G-73658, G-74290, G-74580, G-79848, G-80857, G-84260, H-00301, H-00737, H-01250, H-01398, H-01800, H-01809, H-02041, H-02537, H-03116, H-03395, H-03472, H-03611, H-03612, H-03616, H-03676, H-03766, H-04732, H-04984, H-05342, H-05421, H-05485, H-05560, H-05724, H-06395, H-06557, H-11157, H-12042, H-12155, H-12415, H-13159, H-13474, H-13804, H-14968, H-16244, H-16385, H-16673, H-17449, H-17697, H-17710, H-17779, H-18319, H-18507, H-19604, H-19656, H-19703, H-19713, H-19949, H-20157, H-20158, H-20476, H-21189, H-21194, H-21364, H-21422, H-22284, H-22789, H-22930, H-23188, H-23214, H-23295, H-23386, H-23624, H-23794, H-23950, H-23986, H-24035, H-24036, H-24064, H-24366, H-24533, H-24852, H-24933, H-25769, H-25865, H-26055, H-26158, H-26175, H-26491, H-26861, H-27021, H-27091, H-27324, H-27785, H-28149, H-28437, H-28474, H-28475, H-28476, H-28477, H-28479, H-28480, H-28647, H-28802, H-28888, H-30225, H-30368, H-30473, H-31527, H-32280, H-32334, H-32343, H-32516, H-32714, H-32854, H-33089, H-33127, H-33716, H-35877, H-35880, H-35964, H-36159, H-36742, H-36994, H-36998, H-38332, H-38412, H-38419, H-38574, H-39190, H-39328, H-39466, H-39537, H-39782, H-40341, H-40368, H-40472, H-40899, H-41189, H-41362, H-41370, H-41696, H-41698, H-41699, H-41983, H-42086, H-42923, H-42924, H-42954, H-43492, H-43622, H-44411, H-45007, H-45009, H-45022, H-45130, H-45214, H-45345, H-45467, H-45533, H-45540, H-45557, H-45776, H-46198, H-46262, H-46338, H-46557, H-46721, H-47014, H-47286, H-47385, H-48022, H-48193, H-48413, H-48798, H-49644, H-49647, H-49779, H-50157, H-50677, H-50780, H-51109, H-51321, H-51470, H-51526, H-51953, H-52102, H-52135, H-52409, H-52574, H-52698, H-52705, H-52928, H-53903, H-54297, H-54755, H-54910, H-55066, H-56204, H-56428, H-56584, H-56655, H-56874, H-56885, H-57475, H-57810, H-59028, H-59184, H-60913, H-60957, H-61410, H-61834, H-62275, H-63626, H-64166, H-64860, H-65394, H-65928, H-66714, H-66715, H-67026, H-67056, H-67304, H-67348, H-67457, H-68575, H-68602, H-69488, H-69596, H-69800, H-69966, H-70487, H-70776, H-70984, H-71931,

H-72762, H-73172, H-73510, H-74588, H-74624, H-74626, H-75027, H-76233, H-76451, H-76715, H-77325, H-77329, H-78402, H-78580, H-78956, H-79338, H-79972, H-79976, H-80575, H-81671, H-83145, H-83849, H-84048, H-84545, H-84548, H-84557, H-84651, I-00695, I-07553, I-23108, I-24308, I-27060, I-40510, I-46606, I-47291, I-52320, I-56143, I-58585, I-63139, I-63871, I-65935, I-69995, I-73616, J-30226, J-38409, J-41121, J-42746, J-43002, J-43547, J-44672, J-48171, J-55161, J-67865, K-03032, K-07605, K-08420, K-11414, K-19750, K-27010, K-28466, K-31968, K-33107, K-36823, K-37472, K-41682, K-47672, K-51212, K-58638, K-58899, K-60180, K-66916, K-68582, K-69550, K-71991, K-72145, K-80854, L-06349, L-06734, L-06754, L-09677, L-17188, L-17472, L-17614, L-19064, L-19434, L-24481, L-25427, L-25542, L-29421, L-29504, L-29598, L-29818, L-31492, L-32173, L-32245, L-32272, L-32884, L-33495, L-39306, L-40461, L-40889, L-41455, L-44054, L-48788, L-60630, L-73839, L-76397, L-76847, L-80894, L-81220, L-83965, L-84415, N-04212, N-12307, N-16400, N-20040, N-20495, N-21287, N-28923, N-32254, N-37027, N-46820, N-49170, N-51942, N-64545, N-65407, N-66718, N-66750

SULFUR ORGANIC COMPOUNDS

A-08882, A-20134, A-26254, A-39460, A-44566, A-45145, A-46925, A-47962, A-66977, A-71262, B-08344, B-14692, B-26908, B-38299, B-45707, B-60864, B-75204, C-35956, C-39136, C-39715, C-42928, C-47218, C-48492, C-71044, D-31371, D-33425, D-41979, E-04987, G-41706, H-05421, H-45022, H-51526, I-58585, K-41682, K-72151, L-17614, L-20273, L-29504, L-32354, N-65407

SULFUR OXIDES A-00220, A-00375, A-00896, A-01125, A-01528, A-01687, A-02019, A-02312, A-04068, A-07650, A-08748, A-08882, A-09651, A-09693, A-09785, A-11341, A-11453, A-11590, A-11876, A-11877, A-12470, A-12474, A-12557, A-12773, A-12889, A-15452, A-17076, A-17344, A-17357, A-17464, A-17471, A-18323, A-20134, A-22973, A-23561, A-23865, A-24039, A-24370, A-26254, A-26329, A-27314, A-27617, A-28038, A-28282, A-29519, A-29532, A-29786, A-30218, A-30447, A-30517, A-31315, A-31333, A-31529, A-32060, A-32519, A-32702, A-32855, A-33853, A-34018, A-34096, A-35985, A-36045, A-36212, A-36377, A-37190, A-37752, A-37996, A-38657, A-39460, A-39587, A-39862, A-40159, A-40182, A-40344, A-40401, A-40471, A-41650, A-41877, A-42054, A-42675, A-42676, A-42680, A-42682, A-42685, A-43272, A-44490, A-44566, A-45145, A-46119, A-46558, A-46925, A-47143, A-47410, A-47945, A-47954, A-47959, A-47962, A-47963, A-47965, A-47966, A-48231, A-48849, A-48946, A-49617, A-49852, A-49924, A-50381, A-50938, A-51100, A-51102, A-52277, A-52508, A-52664, A-54622, A-55212, A-58334, A-59775, A-59921, A-60281, A-60283, A-60728, A-60827, A-60866, A-61007, A-61154, A-61183, A-61570, A-63661, A-66955, A-66977, A-67806, A-67940, A-68703, A-69309, A-69353, A-69422, A-71262, A-71273, A-72079, A-74262, A-75089, A-76122, A-76274, A-77367, A-77522, A-79043, A-79280, A-79567, A-79774, A-80334, A-81745, A-81861, A-81916, A-81917, A-81931, A-81935, A-82192, B-05567, B-07549, B-07552, B-08344, B-10618, B-12465, B-14692, B-15322, B-16962, B-18641, B-18698, B-18826, B-19177, B-19571, B-21795, B-24033, B-25590, B-26908, B-26911, B-27569, B-28502, B-29403, B-29680, B-30519, B-32190, B-32231, B-32627, B-33554, B-33918, B-33971, B-35106, B-35513, B-36405, B-36475, B-36552, B-36716, B-37536, B-37809, B-38115, B-38476, B-38504, B-38593, B-40381, B-40892, B-41378, B-41569, B-42991, B-43299, B-44121, B-44838, B-44979, B-45380, B-45468, B-45544, B-45707, B-45757, B-45846, B-46050, B-47086, B-47256, B-47341, B-47677, B-47680, B-47731, B-47821, B-48805, B-48811, B-48879, B-49023, B-49031, B-49477, B-49929, B-49979, B-50154, B-50435, B-50937, B-51101, B-53603, B-55046, B-55678, B-59845, B-60282, B-60849, B-60864, B-61259, B-61741, B-61935, B-62165, B-63474, B-63775, B-64696, B-64898, B-65638, B-65640, B-66624, B-66947, B-67742, B-67954, B-68633, B-68795, B-69131, B-70428, B-70840, B-71412, B-71796, B-71841, B-73031, B-74480, B-75204, B-75387, B-76512, B-78245, B-78890, B-79711, B-81772, B-81773, B-82446, B-83134, B-83613, B-83667, B-84391, C-00126, C-01593, C-02681, C-03119, C-03527, C-05078, C-05586, C-06112, C-06962, C-09983, C-10632, C-11574, C-12593, C-15171, C-17092, C-20030, C-20595, C-20650, C-22517, C-22812, C-22877, C-22879, C-23162, C-23375, C-23907, C-24399, C-24603, C-24970, C-25223, C-26121, C-26122, C-26707, C-26713, C-26729, C-27044, C-27248, C-27294, C-28102, C-28126, C-28671, C-29198, C-29771, C-30014, C-30840, C-31115, C-32476, C-32643, C-35108, C-35441, C-35737, C-35956, C-36800, C-38280, C-38670, C-39022, C-39136, C-39719, C-39762, C-39871, C-41719, C-41763, C-42926, C-42928, C-43672, C-43979, C-43981, C-43985, C-43986, C-44238, C-44253, C-44285, C-45760, C-46034, C-46303, C-47218, C-48392, C-48492, C-49391, C-49509, C-49752, C-49879, C-49992, C-50337, C-51762, C-52992, C-56572, C-56681, C-56865, C-58278, C-59513, C-59814, C-60419, C-60553, C-61103, C-61851, C-61993, C-63848, C-65118, C-65846, C-66606, C-67116, C-68944, C-69174, C-70686, C-71044, C-72017, C-73127, C-74221, C-74346, C-74354, C-74471, C-74942, C-75058, C-79032, C-79842, C-79843, C-80103, C-80259, C-80573, C-82650, C-83495, C-83592, C-84471, C-84660, D-09590, D-09658, D-17102, D-17642, D-19145, D-19966, D-21419, D-22348, D-22359, D-23392, D-23760, D-23845, D-25593, D-26026, D-26086, D-26702, D-27254, D-30705, D-31371, D-31396, D-32666, D-32679, D-33108, D-33309, D-33425, D-33576, D-33858, D-34008, D-35764, D-36806, D-37502, D-37607, D-37994, D-39054, D-39737, D-40896, D-41979, D-42760, D-43170, D-43317, D-44267, D-44799, D-47976, D-48791, D-48850, D-49118, D-49860, D-50307, D-50550, D-50690, D-54881, D-56463, D-56792, D-60574, D-63186, D-63526, D-67690, D-69144, D-70500, D-73286, D-73835, D-74121, D-78193, D-78442, D-78954, D-79343, D-83399, D-84625, E-04987, E-14897, E-29315, E-29774, E-33579, E-37037, E-49185, E-59234, E-78943, E-79132, F-16218, F-41543, F-52013, F-53153, F-55415, F-57580, F-57581, F-80516, F-81496, G-01794, G-03394, G-05504, G-05833, G-06675, G-07098, G-07961, G-11467, G-11942, G-16345, G-18785, G-18987, G-18988, G-19148, G-24153, G-24392, G-24580, G-26274, G-27379, G-28199, G-30788, G-31319, G-32607, G-33509, G-33510, G-33511, G-34398, G-38616, G-38721, G-39494, G-40597, G-41684, G-41706, G-43277, G-43323, G-43636, G-48068, G-49756, G-50318, G-55517, G-57299, G-60625, G-61146, G-61467, G-56044, G-67440, G-71484, G-71536, G-73658, G-74290, G-74580, G-79848, G-80857, G-84260, H-00301, H-00737, H-01250, H-01398, H-01800, H-01809, H-02041, H-02537, H-03116, H-03395, H-03472, H-03611, H-03612, H-03616, H-03676, H-03766, H-04732, H-04984, H-05342, H-05421, H-05485, H-05560, H-05724, H-06395, H-06557, H-11157, H-12042, H-12155, H-12415, H-13159, H-13474, H-13804, H-14968, H-16244, H-16285, H-16675, H-17449, H-17697, H-17710, H-17749, H-17779, H-18319, H-18507, H-19604, H-19656, H-19703, H-19713, H-19949, H-20157, H-20158, H-20476, H-21189, H-21194, H-21364, H-21422, H-22284, H-22789, H-22930, H-23188, H-23214, H-23295, H-23386, H-23624, H-23794, H-23950, H-23986, H-24035, H-24036, H-24064, H-24366, H-24533, H-24852, H-24933, H-25769, H-25865, H-26055, H-26158, H-26175, H-26491, H-26861, H-27021, H-27091, H-27324, H-27785, H-28149, H-28437, H-28474, H-28475, H-28476, H-28477, H-28479, H-28480, H-28647, H-28802, H-28888, H-29443, H-30225, H-30368, H-30473, H-31527, H-32280, H-32334, H-32343, H-32516, H-32714, H-32854, H-32982, H-33089, H-33127, H-33716, H-35613, H-35877, H-35880, H-35964, H-36159, H-36742, H-36994, H-36998, H-38332, H-38412, H-38419, H-38574, H-39190, H-39328, H-39466, H-39537, H-39782, H-40341, H-40368, H-40460, H-40472, H-40899, H-41189, H-41362, H-41370, H-41696, H-41698, H-41699, H-41983, H-42086, H-42923, H-42924, H-42954, H-43492, H-43622, H-44411, H-45007, H-45009, H-45022, H-45130, H-45214, H-45345, H-45467, H-45533, H-45540, H-45557, H-45776, H-46198, H-46262, H-46338, H-46557, H-46721, H-47014, H-47286, H-47385, H-48022, H-48193, H-48413, H-48798, H-48941, H-49644, H-49647, H-49778, H-49779, H-50157, H-50677, H-50780, H-51109, H-51321, H-51470, H-51526, H-51754, H-51953, H-52102, H-52135, H-52409, H-52574, H-52698, H-52705, H-52928, H-53903, H-54297, H-54597, H-54755, H-54910,

H-55066, H-56204, H-56428, H-56584, H-56655, H-56874, H-56885, H-57475, H-57810, H-59028, H-59184, H-59327, H-60913, H-60957, H-61410, H-61834, H-62275, H-63626, H-64166, H-64860, H-65394, H-65928, H-66714, H-66715, H-67026, H-67056, H-67304, H-67348, H-67457, H-68575, H-68602, H-69488, H-69596, H-69800, H-70487, H-70776, H-70984, H-71931, H-72762, H-73172, H-73510, H-74588, H-74624, H-74626, H-75027, H-76233, H-76451, H-76452, H-76715, H-76838, H-77325, H-77329, H-78402, H-78580, H-78956, H-79338, H-79972, H-79976, H-80575, H-81671, H-82435, H-82520, H-83145, H-83849, H-84048, H-84080, H-84545, H-84548, H-84557, H-84651, I-00695, I-07553, I-23108, I-24308, I-27060, I-40510, I-46606, I-47291, I-52320, I-54961, I-56143, I-58585, I-63139, I-63871, I-65935, I-69995, J-73616, J-30226, J-30696, J-38409, J-41121, J-42746, J-43002, J-43547, J-44672, J-48171, J-55161, J-60298, J-67865, K-03032, K-07605, K-08420, K-11414, K-14772, K-19750, K-27010, K-28466, K-31968, K-33107, K-34063, K-36823, K-37472, K-41682, K-44310, K-44377, K-46081, K-47672, K-51212, K-51229, K-58638, K-58899, K-60180, K-66916, K-68582, K-69550, K-71991, K-72145, K-72151, K-80854, L-06349, L-06734, L-06754, L-09677, L-17188, L-17472, L-17614, L-19064, L-19434, L-24481, L-25427, L-25542, L-27677, L-28349, L-29421, L-29504, L-29598, L-29818, L-30620, L-31492, L-32173, L-32245, L-32272, L-32789, L-32884, L-33495, L-35795, L-37943, L-38669, L-39306, L-40461, L-40889, L-41455, L-42021, L-42188, L-42873, L-42874, L-44054, L-47380, L-48719, L-48788, L-50180, L-59722, L-60630, L-73836, L-73839, L-76397, L-76847, L-76965, L-80894, L-81220, L-82278, L-83965, L-84415, N-04212, N-12307, N-16400, N-20040, N-20495, N-21287, N-28923, N-32254, N-37027, N-44066, N-46820, N-49170, N-50867, N-51942, N-63463, N-64545, N-64937, N-65407, N-66718, N-66750

SULFUR PRODUCTION A-79511

SULFUR TRIOXIDE A-01125, A-09693, A-09785, A-15452, A-17344, A-17357, A-18323, A-29532, A-29786, A-30218, A-31315, A-32702, A-33853, A-34096, A-36045, A-36212, A-49852, A-52508, A-54622, A-60283, A-61183, A-63661, A-66977, A-69353, A-69422, A-74262, A-75089, A-81861, B-07552, B-32231, B-32627, B-33554, B-40381, B-41378, B-46050, B-47086, B-48805, B-63775, B-66624, B-68795, B-70428, B-71412, B-73031, B-74480, B-75512, B-81772, B-81773, B-82446, C-01593, C-11574, C-20030, C-20595, C-22877, C-23575, C-24603, C-24970, C-42928, C-44238, C-49992, C-50337, C-63848, D-09658, D-34008, D-37502, D-39054, D-48791, E-29774, E-33579, F-41543, G-26274, G-28199, G-32607, G-40597, G-84260, H-24035, H-39537, H-40460, H-52102, H-52574, H-52928, H-76451, I-07553, I-46606, I-58585, I-65935, K-03032, L-17472, L-29504, L-29818, N-04212, N-64937

SULFURIC ACID A-01125, A-03129, A-03450, A-04068, A-11916, A-13242, A-17076, A-18323, A-23865, A-24370, A-26254, A-26329, A-29532, A-29786, A-30517, A-31935, A-32060, A-32702, A-32855, A-39460, A-42680, A-44566, A-45858, A-49852, A-49924, A-55212, A-63661, A-71262, B-02541, B-05567, B-06587, B-07552, B-18826, B-22943, B-24110, B-25178, B-32461, B-33620, B-33918, B-35111, B-36532, B-36716, B-38439, B-44793, B-45707, B-45846, B-46086, B-47680, B-52852, B-54799, B-55046, B-60864, B-63540, B-69131, B-69965, B-75204, B-76512, C-00626, C-00941, C-01593, C-03119, C-09983, C-18264, C-20595, C-24970, C-30840, C-36693, C-42928, C-43981, C-43985, C-44177, C-49992, C-80103, D-09658, D-34008, D-43317, D-50744, E-29774, E-76047, F-41543, G-03394, G-06675, G-11467, G-18988, G-26873, G-27379, G-28199, G-32607, G-33510, G-34398, G-38721, G-40597, G-50916, G-71536, G-73658, H-05421, H-11452, H-18226, H-18319, H-25750, H-35964, H-36742, H-36998, H-38574, H-39190, H-39627, H-41362, H-41696, H-48167, H-52705, H-52928, H-68770, H-70487, H-76451, H-84557, I-07553, I-23108, I-39031, I-40510, I-46606, I-52320, J-30696, K-08420, K-10168, K-19750, K-27010, K-28466, K-36823, K-37472, K-47672, K-51057, K-51212, K-51229, K-58899, K-60180, L-06349, L-06734, L-29504, L-29818, L-40461, L-41455, L-48788

SULFURIC ACID PLANTS B-81772, B-81773

SUPERPHOSPHATE PLANTS A-79511, A-84479, B-81772, B-81773, B-81944, C-80935

SURFACE COATING OPERATIONS A-09785, A-32855, A-37190, A-37996, A-40344, A-45858, A-58939, B-52852, H-40201, J-30696, L-32173, L-32245

SURFACE COATINGS A-27930, A-32855, A-37190, B-43481, C-26209, G-04145, G-18988, I-07553, I-24308, I-27060, I-40833, I-58585, J-30696

SURFACE PROPERTIES A-32060, B-26745, B-33918, B-46086, B-57706, E-29774, F-26990, F-57580, F-57581, G-28037, I-00085, I-00695

SURFACTANTS B-18830

SURVEY METHODS A-69309, B-09664, C-36693, C-56572, C-58278, D-49118, D-50307, D-60574, K-72145, L-29598, L-40889, L-57270

SUSPENDED PARTICULATES A-00220, A-00375, A-00896, A-01125, A-01528, A-01687, A-02312, A-03129, A-04068, A-05601, A-06241, A-06371, A-08882, A-09785, A-09799, A-11453, A-11876, A-12476, A-12747, A-15452, A-17377, A-18323, A-18656, A-22875, A-23561, A-24039, A-27314, A-27930, A-29519, A-29532, A-29786, A-31144, A-31283, A-31529, A-32060, A-32139, A-32576, A-32702, A-34018, A-34334, A-36045, A-36377, A-39460, A-40180, A-40344, A-41877, A-42751, A-43014, A-44490, A-44605, A-46925, A-47143, A-47188, A-47945, A-47954, A-48231, A-49617, A-50013, A-52508, A-53751, A-57231, A-59494, A-60281, A-60283, A-60727, A-60827, A-61564, A-61800, A-68703, A-69039, A-71273, A-71477, A-74586, A-75077, A-75089, A-79567, A-81343, A-82279, B-02541, B-04853, B-05567, B-07190, B-07549, B-07552, B-07664, B-07815, B-09773, B-10618, B-11686, B-13771, B-16826, B-19177, B-22853, B-23310, B-24110, B-24116, B-25038, B-25433, B-25590, B-25658, B-26244, B-26745, B-26908, B-27282, B-28502, B-28783, B-28786, B-30814, B-32232, B-32712, B-33971, B-35106, B-35448, B-35513, B-36532, B-36552, B-36755, B-38115, B-38188, B-38439, B-41378, B-41418, B-42104, B-42172, B-43481, B-43533, B-43863, B-44121, B-44979, B-45707, B-46086, B-47256, B-47341, B-47821, B-48805, B-49023, B-49031, B-52094, B-52172, B-52179, B-57706, B-58879, B-59230, B-60255, B-64092, B-70428, B-70658, B-70840, B-71412, B-74680, B-75204, B-77838, B-81645, C-01593, C-03119, C-03527, C-10632, C-16801, C-18230, C-22517, C-22877, C-24118, C-24279, C-26713, C-28671, C-35108, C-35956, C-36693, C-39022, C-41763, C-43672, C-43981, C-43985, C-44710, C-48392, C-49879, C-52206, C-53523, C-59513, C-67116, C-69174, C-71044, C-74471, C-75339, C-80103, C-81439, D-06809, D-09590, D-17986, D-19145, D-19966, D-21419, D-23845, D-24736, D-26026, D-26086, D-26702, D-27254, D-28771, D-30705, D-31371, D-33309, D-33576, D-33858, D-35764, D-36806, D-39737, D-41979, D-43317, D-44267, D-47976, D-48791, D-49260, D-50307, D-51929, D-52575, D-54881, D-56464, D-58218, D-58339, D-58427, D-67690, D-69144, D-73835, D-74121, D-76890, D-79343, D-84625, E-04987, E-29774, E-30126, E-76047, F-44721, G-01794, G-04145, G-06485, G-07098, G-08702, G-11467, G-16345, G-18809, G-18988, G-19148, G-24126, G-24392, G-24580, G-26274, G-27379, G-28139, G-28199, G-30788, G-33510, G-33872, G-34398, G-38721, G-39494, G-40527, G-40597, G-41706, G-49607, G-50318, G-50414, G-50916, G-52638, G-60228, G-60625, G-61146, G-61467, G-66044, G-71484, G-73658, G-74290, G-74369, G-74580, G-84137, G-84260, H-00301, H-01398, H-01800, H-02379, H-02537, H-03116, H-03395, H-03472, H-03549, H-03611, H-03613, H-03616, H-03676, H-04544, H-04816, H-05485, H-05724, H-06395, H-07255, H-08884, H-11157, H-11407, H-11452, H-11650, H-12045, H-12415, H-12552, H-12554, H-16092, H-16244, H-16567, H-16673, H-17710, H-18270, H-19539, H-19604, H-19949, H-20157, H-21189, H-21364, H-22789, H-23295, H-23516, H-23624, H-23794, H-23874, H-24358, H-24366, H-25865, H-26158, H-26861, H-27021, H-28437, H-28475, H-28480, H-28802, H-28888, H-30225, H-30368, H-32343, H-33089, H-33468, H-35613, H-35964, H-35992, H-36742, H-36998, H-38332, H-39190, H-39466, H-39537, H-39684, H-39887, H-39902, H-40341, H-41370, H-41696, H-42086, H-42857, H-42954, H-43492, H-43622, H-43663, H-44295, H-45467, H-46198, H-47806, H-48022, H-48167, H-48193, H-48374, H-48413, H-49644, H-49647, H-51953, H-52135, H-52928,

H-56424, H-56874, H-56885, H-57475, H-64860, H-65103, H-67026, H-68770, H-69800, H-70487, H-73172, H-79976, H-81671, H-83145, H-83854, H-83856, H-84651, I-07553, I-27060, I-39031, I-54961, I-58585, J-43002, K-03032, K-07605, K-08420, K-19750, K-27010, K-31968, K-36823 K-46081, K-47572, K-51212, K-51229, K-58899, K-69550, K-72145, K-74109, K-80854, L-06349, L-06734, L-09677, L-17188, L-17614, L-19064, L-24010, L-24481, L-27677, L-29421, L-29504, L-29598, L-29818, L-30620, L-32173, L-32245, L-32272, L-32884, L-33495, L-37943, L-42021, L-42188, L-44054, L-47380, L-48788, L-50180, L-52026, L-73836, L-73839, L-76847, L-76965, L-80894, L-81220, L-82278, N-04212, N-16400, N-17260, N-28923, N-46820, N-49170, N-50748, N-50867, N-64545

SWEDEN A-00220, A-00640, A-05090, A-74262, B-15372, B-25195, B-67742, C-00126, C-00260, C-00264, C-01313, C-01349, C-02042, C-02565, C-04405, C-04463, C-11626, D-01872, F-01677, F-02337, F-02517, F-03062, G-01096, G-01728, G-02539, G-03394, G-04145, H-00301, H-00631, H-01800, H-02041, H-02379, H-02382, H-03571, H-32982, H-38574, I-00085, K-68582, L-46586, N-66750

SWEET PEA H-16222

SWITZERLAND A-83637, B-83667

SYNERGISM A-39587, A-69039, B-26911, B-38476, C-18283, D-26086, G-02539, G-03394, G-08201, G-27379, G-28139, G-33276, G-33509, G-33511, G-41036, G-41684, G-41706, G-43636, G-48693, G-60625, G-66668, G-68583, G-73658, G-74290, G-74580, H-04544, H-23624, H-23950, H-26158, H-32736, H-38412, H-38568, H-45022, H-45557, H-46262, H-52135, H-52698, H-52928, H-54910, H-56637, H-61834, H-62275, H-67056, H-71931, H-76451, H-77329, H-79338, H-80575, I-58585, K-41682, N-51942, N-64937

SYNTHETIC FIBERS A-03129, A-40344, A-45858, B-37402, B-45707, B-55046, B-59230, B-60864, C-04540, D-09590, H-48377, I-07553, I-40510

SYNTHETIC RUBBER A-37190, A-40344, A-45858, B-59230, I-07553

SYNTHETIC RUBBER PLANTS A-79280

T

TALL STACK ISSUE L-80894

TAPE SAMPLERS (TRANSMITTANCE) C-11574, E-04987

TAR (MATERIAL) A-38657, A-72133, B-16962, B-38593, B-38874, B-67700, B-71796, C-35956, D-51929, G-26274, H-11157, H-23661, H-28477, H-30225, H-36742, H-41696, H-45022, H-50677

TARS (POLLUTANTS) A-44490, B-30519, B-40414, B-47680, C-80103, D-33309, D-39182, G-71948, G-72961, H-28475, H-32344, H-45007

TAXATION K-37472

TEA H-84579

TECHNICAL SOCIETIES K-19818, N-37027

TEETH G-83177, G-83798

TEFLON A-47048, B-55046, B-59230, G-45683, I-39031

TELLURIUM COMPOUNDS A-76638, A-81343

TEMPERATURE A-08486, A-09214, A-09321, A-09332, A-11541, A-18323, A-27930, A-30218, A-31581, A-33853, A-34096, A-37562, A-39635, A-40344, A-43403, A-45858, A-48116, A-48231, A-48572, A-54622, A-58370, A-65064, A-76411, B-07552, B-07664, B-12465, B-18826, B-18830, B-22923, B-24355, B-32461, B-32554, B-37544, B-37809, B-38115, B-38148, B-38504, B-40381, B-41378, B-42078, B-44716, B-45004, B-47125, B-47466, B-48480, B-55046, B-61741, B-66624, B-67217, C-02565, C-04458, C-08077, C-09770, C-22879, C-24008, C-24114, C-24886, C-25806, C-27769, C-29771, C-31827, C-35956, C-41064, C-44083, C-44238, C-44552, F-01677, F-18427, F-19175, F-21632, F-32952, F-57580, F-57581, F-62189, G-04145, G-08030, G-08702, G-45683, G-68583, H-00265, H-06342, H-06459, I-08076, I-40510, I-54961

TEMPERATURE (ATMOSPHERIC) A-09785, A-34334, A-48048, A-80507, B-45468, C-06279, C-06338, C-07710, C-48392, C-68944, D-09590, D-40896, D-44799, E-04987, E-37037, E-44277, G-01674, G-68583, H-05724, H-22930, H-25273, H-26711, H-28446, H-28474, H-28476, H-30301, H-32535, H-32536, H-33716, H-38568, H-40202, H-40341, H-41189, H-42923, H-48798, H-53376, I-00695, I-27060, I-46606, L-40889, N-04212, N-66750

TEMPERATURE SENSING INSTRUMENTS A-31581, C-26713, C-35956, N-20495

TENNESSEE A-00375, B-02962, D-26086, D-56464, H-17697, H-24282, H-38404, L-44598

TETRAETHYL LEAD A-29786, A-31315, C-36125, D-34008, G-26274, G-44867, H-41699

TEXAS G-26743, G-44590, K-37472, L-17614, L-24481

TEXTILE MILLS A-34018, A-40344, A-45858, A-47963, A-49924, A-66977, B-24033, B-45707, D-09590, D-40896, K-10168, L-37747, L-48788

TEXTILES A-03129, A-40344, A-43272, A-45858, A-69039, B-05567, B-07552, B-37402, B-45707, B-55046, B-59230, B-60864, C-04540, D-09590, G-07098, G-24153, H-48377, I-07553, I-24308, I-27060, I-40510, I-46606, L-48788

THERMAL RADIATION B-32461, F-32952, F-62189, L-48788

THERMISTORS C-35956

THERMOCOUPLES C-35956

THERMODYNAMICS A-05811, B-18826, B-32627, B-38587, B-44716, F-01677, F-03062, F-04468, F-13998, F-18863, F-19175, F-20932, F-21389, F-21632, F-57580, F-57581, I-00085

THERMOMETERS C-35956

THIN-LAYER CHROMATOGRAPHY B-29680, C-06338, C-26707, C-79032, H-02382

THRESHOLDS A-01687, A-28038, A-50242, A-51282, B-02541, B-38476, B-47680, C-24222, C-27131, C-35956, C-80103, E-44030, G-01047, G-06288, G-12282, G-27895, G-28139, G-29807, G-32596, G-32605, G-33561, G-34398, G-36947, G-37791, G-38721, G-41224, G-41684, G-41685, G-41686, G-41687, G-41688, G-49223, G-52147, G-57024, G-68551, G-74821, G-79848, H-04984, H-07047, H-16244, H-19211, H-19949, H-21687, H-23576, H-23794, H-23950, H-24064, H-24366, H-25273, H-28476, H-28479, H-36785, H-38407, H-38412, H-38754, H-40201, H-41370, H-41904, H-42924, H-42958, H-51905, H-62548, H-65558, H-66035, H-66798, H-67453, H-68575, H-76838, H-84290, K-17375, K-58638, K-60887

THROUGHPUT K-78880

THUNDERSTORMS H-25769

TIMED FUEL INJECTION L-24122

TIN B-48811, I-00695, I-40510

TIN COMPOUNDS A-18449, A-51100, A-60728, A-64926, A-75077, A-76638, A-80994, A-81343, B-45380, B-58879, B-80950, C-75339, C-82552, D-50307, E-29910, K-68224

TIP BURN A-31144, D-23760, D-37473, H-00631, H-00979, H-01250, H-01398, H-01506, H-02049, H-03676, H-03873, H-04679, H-04732, H-04904, H-05485, H-05585, H-10342, H-14968, H-16150, H-16399, H-17163, H-17697, H-17822, H-19358, H-22496, H-23188, H-23794, H-24566, H-25499, H-28830, H-29277, H-30368, H-31124, H-32280, H-32282, H-38411, H-38568, H-39183, H-39466, H-39902, H-40599, H-41699, H-44345, H-44595, H-50415, H-51109, H-54597, H-57810, H-58941, H-62597, H-76715

TISSUE CULTURES G-32596, G-43277, H-21364

TISSUES C-00626, C-00941, C-03503, C-04691, C-04757, C-25441, C-26744, C-50093, C-55789, C-68559, D-77485, G-01338, G-04849, G-04983, G-07013, G-07098, G-07917, G-08030, G-10842, G-11000, G-23763, G-25946, G-28041, G-28199, G-32596, G-33276, G-33561, G-35569, G-37684, G-41685, G-43277, G-49164, G-49756, G-52638, G-54302, G-56934, G-56959, G-66668, G-74823, G-84236, H-00187, H-00265, H-00266, H-00633, H-00737, H-00944, H-01092, H-03570, H-03571, H-03572, H-04728, H-04923, H-04997, H-05004, H-06354, H-06404, H-10841, H-10843, H-13203, H-24944, H-26734, H-26742, H-26861, H-34121, H-40916, H-42907, H-42924, H-46338, H-46719, H-54710, H-69162, H-76901, H-77377, N-64545

TITANIUM B-73031, I-00085, I-65935

TITANIUM COMPOUNDS A-09785, A-51100, A-53955, A-64926, A-81343, C-09560, D-50307, E-29910, E-43424

TITRIMETRIC METHODS C-83495

TOBACCO A-69039, B-02541, C-00626, D-09590, E-76047, H-01800, H-01809, H-04984, H-12042, H-12045, H-21364, H-23386, H-62548, H-67304, H-68602, H-79976

TOKYO A-32855, B-07549, C-15171, G-50419, K-36823, L-29818, L-33722

TOLUENES A-32855, B-62165, C-31115, C-38670, C-39136, C-80259, F-68048, G-80197, K-51057

TOMATOES C-00626, C-00941, C-04757, H-00631, H-00964, H-01506, H-01800, H-02200, H-03629, H-03729, H-03873,

H-04683, H-04728, H-04984, H-06413, H-10673, H-13247, H-15213, H-16245, H-16900, H-17449, H-19863, H-21000, H-22284, H-22624, H-23222, H-23386, H-24358, H-24852, H-25099, H-26717, H-28483, H-28600, H-34880, H-36787, H-41699, H-42958, H-56241, H-79972, H-80067, H-83885, H-84651, K-26738

TOPOGRAPHIC INTERACTIONS A-00375, A-02312, A-09785, A-23561, A-48048, B-25195, C-42926, D-23760, D-26086, D-26702, D-31371, D-33309, E-33092, G-01794, G-19148, G-39219, G-48030, H-11452, H-15604, H-25769, H-32289, H-36996, I-07553, J-32706, L-17614, N-49170

TOXIC TOLERANCES A-00640, A-47410, A-50242, B-02541, B-06587, B-19571, C-24970, G-00165, G-01047, G-01096, G-02539, G-03246, G-03394, G-04734, G-04983, G-07917, G-08031, G-10842, G-21455, G-22628, G-23003, G-30387, G-34398, G-35569, G-37139, G-39813, G-41036, G-41685, G-41686, G-41687, G-41688, G-48030, G-56933, G-60228, G-72961, G-73658, H-00301, H-00944, H-01092, H-01398, H-01705, H-03395, H-04919, H-05004, H-09553, H-10673, H-10711, H-10841, H-10843, H-13474, H-13985, H-16245, H-17620, H-17697, H-17749, H-18319, H-18507, H-18704, H-20400, H-20690, H-21687, H-22496, H-22930, H-23188, H-23576, H-23794, H-23986, H-24036, H-24064, H-24852, H-25865, H-26055, H-26175, H-26734, H-28031, H-28479, H-28480, H-28483, H-28679, H-28802, H-28888, H-29206, H-30298, H-32282, H-32343, H-32344, H-32771, H-34880, H-35877, H-36159, H-36785, H-37346, H-38017, H-38407, H-38568, H-39190, H-39466, H-39607, H-39887, H-39902, H-39932, H-39986, H-40202, H-40916, H-41439, H-41696, H-41699, H-41904, H-42924, H-42958, H-43663, H-44595, H-45007, H-45022, H-45345, H-45533, H-45557, H-45776, H-46198, H-46217, H-46557, H-48022, H-48403, H-48798, H-49561, H-49778, H-50157, H-50163, H-50780, H-51109, H-51470, H-51905, H-52102, H-52397, H-52698, H-53376, H-53903, H-56655, H-56963, H-58507, H-59184, H-60913, H-60957, H-60961, H-61834, H-62275, H-64166, H-64427, H-65558, H-65928, H-66714, H-66798, H-67056, H-67348, H-67453, H-67457, H-67480, H-69488, H-69800, H-69966, H-70607, H-71931, H-73172, H-73510, H-74617, H-74624, H-74626, H-74722, H-75027, H-76452, H-76838, H-78681, H-80189, H-81495, I-24308, K-31968, K-51057

TOXICITY A-12548, A-17405, A-18449, A-27314, A-27595, A-27930, A-31333, A-34334, A-36045, A-37190, A-37721, A-37996, A-39460, A-42054, A-47048, A-47061, A-47954, A-47959, A-48849, A-49924, A-50242, A-51282, A-52664, A-55601, A-60421, A-60728, A-60866, A-61570, A-69039, A-71262, A-71273, A-71477, A-79511, B-09664, B-38476, B-47731, B-60864, B-72139, B-75138, C-06494, C-07719, C-24222, C-46303, C-48492, C-64090, C-67116, E-05054, E-33092, E-64013, F-52013, F-55415, G-05504, G-05833, G-06288, G-06485, G-06497, G-07013, G-07917, G-08201, G-10333, G-10842, G-11444, G-12282, G-12403, G-12550, G-13215, G-14112, G-14319, G-15040, G-16345, G-18809, G-19055, G-19148, G-19215, G-22628, G-22629, G-23711, G-24153, G-24494, G-25469, G-26274, G-26846, G-27379, G-27895, G-28139, G-28199, G-28429, G-29415, G-30145, G-30841, G-32152, G-32596, G-32601, G-32605, G-32606, G-32607, G-33276, G-33505, G-33509, G-33510, G-33511, G-33561, G-33872, G-34398, G-34851, G-35569, G-36411, G-36723, G-36751, G-36947, G-37139, G-37282, G-37795, G-38106, G-38616, G-38721, G-39219, G-39494, G-39497, G-39799, G-39810, G-39813, G-39924, G-39931, G-40527, G-40635, G-41036, G-41224, G-41686, G-41687, G-41706, G-43323, G-43896, G-44589, G-44594, G-44867, G-45055, G-45683, G-46085, G-47807, G-48068, G-48636, G-48637, G-48693, G-49223, G-49271, G-49448, G-49607, G-49756, G-50161, G-50371, G-50414, G-51473, G-52029, G-52147, G-52638, G-52686, G-52764, G-54302, G-55517, G-56933, G-57024, G-57701, G-59073, G-60228, G-60625, G-60748, G-67321, G-67440, G-68583, G-71484, G-71933, G-71948, G-72083, G-72961, G-73658, G-74580, G-79848, G-80197, G-83179, G-84266, H-02516, H-04544, H-04848, H-04917, H-04918, H-04919, H-04923, H-04984, H-05004, H-05421, H-06459, H-07047, H-08513, H-08884, H-10150, H-10673, H-10711, H-10841, H-10843, H-12540, H-12552, H-12553, H-13203, H-13474, H-13985, H-16399, H-16472, H-16617, H-16896, H-19539, H-19949, H-20690, H-23386, H-23576, H-23624, H-23794, H-23950, H-24944, H-25366, H-26718, H-26734, H-26742, H-26861, H-27303, H-27907, H-27923, H-28035, H-28443, H-28446, H-28679, H-29616, H-32289, H-32291, H-33906, H-35992, H-36159, H-36785, H-36883, H-36994, H-36996, H-37346, H-38017, H-38332, H-38343, H-38568, H-38754, H-39183, H-39190, H-39607, H-39627, H-39895, H-39923, H-40201, H-40341, H-40599, H-40899, H-40916, H-42857, H-42924, H-42958, H-43492, H-43663, H-44345, H-45533, H-45781, H-46051, H-46198, H-46217, H-46262, H-46338, H-46719, H-46997, H-47385, H-48022, H-48167, H-48193, H-48377, H-48403, H-48413, H-48639, H-49316, H-49561, H-49644, H-49778, H-49779, H-50157, H-50163, H-50415, H-50677, H-50780, H-51109, H-51321, H-51470, H-51905, H-52102, H-52135, H-52306, H-52397, H-52574, H-52698, H-52705, H-52928, H-53376, H-53903, H-54297, H-54755, H-54910, H-55654, H-56204, H-56240, H-56655, H-56963, H-57859, H-59028, H-59935, H-60559, H-60560, H-60760, H-60907, H-60913, H-60957, H-60961, H-61000, H-62275, H-63626, H-64758, H-65380, H-65394, H-65558, H-65928, H-66035, H-66798, H-67056, H-67347, H-67348, H-67453, H-67480, H-68575, H-68770, H-69488, H-69596, H-69800, H-70607, H-73172, H-74624, H-74626, H-74721, H-74722, H-75027, H-76451, H-76452, H-76715, H-76838, H-81771, H-83797, H-84089, H-84477, K-17375, K-26738, K-36823, K-38197, K-47672, K-51057, K-58638, K-60887, K-71991, L-25642, L-38669, L-42188, L-44598, N-17260, N-20040, N-44066, N-46820, N-49170, N-50867, N-51942, N-63463, N-64545, N-64937, N-66750

TRACE ANALYSIS A-09695, A-09697, A-57231, A-59257, A-75077, A-81343, C-11691, C-12451, C-15355, C-21806, C-23517, C-24018, C-26713, C-27331, C-27927, C-32534, C-32966, C-40422, C-42926, C-44253, C-44596, C-53523, C-55789, C-61993, C-68559, C-69765, C-75339, D-07579, D-33017, D-33858, D-62438, E-43424, H-28443, H-33290, H-45467, H-48374, H-50959, H-65179, N-20495

TRACERS C-07860, C-27248, C-32966, C-35956, E-30126, E-33579, E-43855, E-78793, E-78943, G-33561, G-41685, H-02382, H-05399, H-10150

TRACHEA G-10247, G-40597, G-49223

TRACHEAL CANCER G-07961

TRANSMISSOMETERS C-32534, C-49879, C-59513

TRANSPORT A-15452, A-23561, A-36045, A-42054, A-44566, A-70727, C-23286, C-44177, D-49860, D-58218, D-77485, E-37013, E-78793, E-78933, G-36947, G-67325, H-19949, H-23661, H-45009, L-42810, N-52010

TRAPPING (SAMPLING) C-06494, C-07871, C-16801, C-32476, C-48492, G-01096

TRAY TOWERS A-12476, A-12676, B-43299, B-45078, B-47054, B-47466, B-52838, B-60075

TREATED FABRICS B-77475, C-60278, C-60410, C-66753, D-66083

TREES A-13353, A-13615, A-34018, A-52664, A-61564, A-83543, B-09664, B-19571, B-38476, B-45468, B-48879, B-84391, C-04757, C-05892, C-11915, C-20540, C-23683, C-24970, C-33929, C-56865, D-23760, D-25093, D-37607, D-53889, D-56792, E-49433, G-01338, G-50318, G-81181, G-81250, H-00301, H-00737, H-01398, H-01557, H-01800, H-01809, H-02049, H-02379, H-03116, H-03395, H-03676, H-03766, H-03860, H-04672, H-04904, H-05560, H-05585, H-07255, H-08884, H-10342, H-10673, H-11407, H-11456, H-11466, H-11650, H-12042, H-13203, H-15501, H-15604, H-15838, H-16092, H-16152, H-16222, H-16385, H-16673, H-17697, H-17710, H-17822, H-18267, H-18507, H-19124, H-19539, H-21062, H-21189, H-21194, H-21364, H-21687, H-22084, H-22085, H-22092, H-22887, H-22930, H-23188, H-23214, H-23295, H-23516, H-23576, H-23639, H-23661, H-23950, H-23986, H-24024, H-24064, H-24330, H-24366, H-24566, H-25099, H-25499, H-25750, H-25769, H-26175, H-26491, H-26691, H-27091, H-28476, H-28802, H-29277, H-30298, H-32286, H-32334, H-32344, H-32516, H-32535, H-32714, H-32897, H-33716, H-35877, H-35880, H-35964, H-35992, H-37346, H-38574, H-39183, H-39190, H-39537, H-39684, H-39887, H-39932, H-40341, H-40472, H-40599, H-40899, H-41439, H-41482, H-41904, H-41983, H-42086, H-42954, H-43492, H-43663, H-45007, H-45130, H-45160, H-45474, H-45540, H-45557, H-45604, H-45663, H-45776, H-46198, H-46217,

H-46338, H-46557, H-46719, H-46733, H-47286, H-47385, H-48022, H-48291, H-48377, H-48556, H-48941, H-50157, H-50780, H-50959, H-51109, H-51271, H-51321, H-51754, H-52102, H-52651, H-52829, H-52994, H-54297, H-54910, H-55654, H-56584, H-56637, H-56788, H-56874, H-56885, H-57475, H-57810, H-58506, H-58507, H-59028, H-59327, H-60913, H-60961, H-62597, H-64860, H-68122, H-69966, H-70279, H-70487, H-71078, H-72132, H-73172, H-73518, H-74459, H-74588, H-74617, H-74624, H-75027, H-77050, H-77325, H-77329, H-77390, H-77391, H-78058, H-78580, H-78681, H-79309, H-79635, H-80067, H-80189, H-80493, H-81288, H-81771, H-82498, H-83082, H-84558, H-84579, I-63139, K-26738, L-06754, L-31492, L-46561

TRENDS A-43014, A-60727, A-60728, A-60729, A-60866, A-61007, B-43108, B-60849, B-60864, B-61259, C-66753, D-70500, D-73286, D-77485, D-78193, D-79343, G-41706, H-71098, H-74459, H-77050, J-67865, K-80854, L-41455, L-42188

TRUCKS A-12557, B-07549, I-23108, J-30696, K-72151

TUBERCULOSIS D-17642, G-06675, G-07961, G-11942, G-18987, G-36751, G-44867, J-30226

TUMORS G-02539, G-07013, G-07961, G-11000, G-19055, G-66044, G-73658, G-74580, H-11452

TUNED LASER SPECTROMETRY C-79835

TURBIDIMETRY A-33853, C-32534, C-35956, C-39719, C-43979, C-43985, E-04987, K-08420

TURBULENCE (ATMOSPHERIC) A-44566, C-22877, C-44177, E-29774, E-33092, E-43855, E-79132, N-04212

TURNIPS H-80067

U

ULTRASONICS A-09799, C-44881

ULTRAVIOLET RADIATION A-27930, B-45468, C-22879, C-26485, C-44238, C-66753, C-80103, C-80573, E-72995, F-02337, F-02517, F-80516, G-27379, G-31319, G-32607, H-51321, K-19818

ULTRAVIOLET SPECTROMETRY C-20650, C-22812, C-32534, C-39719, C-43979, C-43986, C-49509, C-50470, C-63848, C-66753, C-69174, C-83495, F-02517

UNDERFIRE AIR A-46925

UNITED KINGDOM A-00375, A-00896, A-06371, A-17377, A-27314, A-27930, A-31134, A-31283, A-32060, A-34334, A-44605, A-47061, A-51282, A-58939, B-07664, B-24033, B-26908, B-30519, B-35513, B-36716, B-37536, B-49023, B-52179, B-67217, B-67846, B-70428, C-16801, C-17092, C-17117, C-21730, C-24222, C-26203, C-30007, C-34125, C-34126, C-49879, C-82552, D-06809, D-52811, D-58218, E-64013, F-19175, F-39861, F-57581, F-78035, G-15040, G-18987, G-39494, G-43896, G-79848, H-11157, H-13213, H-16244, H-19604, H-24366, H-39493, H-40472, H-56428, H-70607, H-78402, H-79129, H-80189, L-17614, L-39306, L-39749, L-44[illegible], L-44598, L-46586, N-04212, N-37027, N-64545

UNITED STATES A-00220, A-00340, A-00375, A-00640, A-00896, A-02019, A-02312, A-03450, A-05601, A-07650, A-08882, A-09785, A-12095, A-32060, A-33853, A-39862, A-40159, A-47143, A-48048, A-67806, A-68912, A-79567, B-02962, B-04853, B-07190, B-09664, B-18144, C-00260, C-00626, C-01349, C-02565, C-26909, C-44710, D-09590, D-09658, D-23760, D-23845, D-24736, D-24801, D-26086, D-26702, D-28188, D-33080, D-37473, D-39737, D-42760, D-49860, D-50307, D-52578, D-55187, D-56463, D-56464, D-56465, D-56792, D-63526, E-29774, E-33092, E-37037, F-01677, G-01096, G-04145, G-04849, G-18785, G-23763, G-24580, G-26743, G-28199, G-30788, G-44590, H-00265, H-00266, H-00301, H-01092, H-01705, H-01800, H-01809, H-02200, H-03613, H-03616, H-03629, H-03766, H-04848, H-05342, H-06395, H-06404, H-06459, H-07255, H-11407, H-12045, H-13474, H-16244, H-16896, H-17697, H-20573, H-22084, H-22092, H-22887, H-24282, H-26718, H-27030, H-28031, H-28830, H-28899, H-33089, H-33127, H-33468, H-37403, H-38404, H-44345, H-45604, H-48374, H-51484, H-52651, H-52829, H-52994, H-53370, H-58507, H-59935, H-67026, H-68394, H-68602, H-70487, H-70984, H-80493, H-80535, I-00085, I-00695, J-43002, J-44672, J-55161, K-03582, K-08420, K-11414, K-19750, K-27010, K-36823, K-37472, K-38197, K-47672, K-51212, K-51229, K-58638, K-68582, L-06349, L-06734, L-06938, L-06939, L-09677, L-17614, L-24122, L-24481, L-32173, L-32245, L-32272, L-44054, L-44598, L-48788, L-66700, N-04212, N-28923, N-63463

UPPER ATMOSPHERE E-40271

URANIUM COMPOUNDS A-17883, A-59921, A-75077, A-76638, A-81343, B-12127, B-50652, C-04463, C-25952, C-75339, D-30058, D-56463, D-56464, D-56465, G-28429, I-08076

URBAN AREAS A-00220, A-08882, A-09785, A-11453, A-13615, A-22973, A-23865, A-25305, A-31315, A-32060, A-32855, A-34334, A-36377, A-37190, A-37996, A-40471, A-42054, A-46558, A-47061, A-47143, A-47945, A-52277, A-52664, A-55922, A-58334, A-66955, A-66977, A-72079, B-28502, B-38476, B-44638, B-45468, C-11915, C-12334, C-18344, C-20701, C-22812, C-24222, C-25487, C-26713, C-31115, C-38905, C-39762, C-40705, C-44174, C-44177, C-44285, D-07579, D-09590, D-10619, D-17102, D-17986, D-18537, D-19145, D-19966, D-21419, D-22348, D-22359, D-23392, D-23845, D-24736, D-25093, D-26026, D-26086, D-27254, D-28097, D-28771, D-31371, D-31396, D-33080, D-33108, D-33309, D-33425, D-33576, D-34008, D-35764, D-36806, D-37473, D-37502, D-37607, D-37823, D-37994, D-39054, D-39182, D-39737, D-40896, D-41979, D-42760, D-43170, D-43317, D-44267, D-44799, D-47976, D-47982, D-48791, D-48850, D-49260, D-49860, D-50307, D-50550, D-50690, D-50744, D-51929, D-52575, D-52578, D-52811, D-53889, D-54881, D-55187, D-56792, D-58339, D-58427, D-63186, D-67690, D-71362, D-77512, D-78193, E-29774, E-37639, E-49185, E-49433, E-72995, G-06675, G-10333, G-12282, G-12532, G-14477, G-18988, G-19215, G-19880, G-23763, G-26274, G-28199, G-28754, G-29043, G-29415, G-30183, G-30788, G-31234, G-32152, G-32596, G-32607, G-33766, G-34398, G-37282, G-37569, G-37791, G-38106, G-38616, G-38721, G-38942, G-40920, G-41706, G-44867, G-47905, G-47906, G-48030, G-48636, G-48697, G-49164, G-49271, G-50318, G-50371, G-50419, G-56931, G-56933, G-57701, G-61646, H-03116, H-08884, H-12533, H-12554, H-17163, H-17449, H-17697, H-18269, H-18507, H-18704, H-20573, H-20917, H-22930, H-23188, H-23295, H-24036, H-27030, H-27091, H-28437, H-29597, H-30142, H-32672, H-33127, H-35880, H-35964, H-36883, H-36994, H-36996, H-36998, H-37480, H-38574, H-39607, H-39627, H-39895, H-40472, H-41362, H-41904, H-41983, H-43226, H-45540, H-46198, H-46217, H-46733, H-46997, H-47385, H-48167, H-48193, H-48374, H-48377, H-48556, H-48941, H-50959, H-51109, H-51470, H-51484, H-51754, H-52574, H-54597, H-55066, H-56584, H-56637, H-56874, H-56885, H-57475, H-58506, H-58507, H-58777, H-58941, H-59327, H-70279, H-72762, H-73518, H-77050, I-00695, I-46606, I-47291, I-52320, I-54961, I-58585, I-73616, J-30696, J-32706, J-60298, K-17375, K-33107, K-36823, K-38197, K-44310, K-46081, K-69550, K-80854, L-06349, L-09677, L-17614, L-29598, L-29818, L-31492, L-32354, L-33495, L-33722, L-35795, L-37747, L-37943, L-38573, L-38669, L-40889, L-41455, L-42021, L-42874, L-46561, L-60630, L-73836, N-16400, N-32254, N-50748, N-63463, N-65407, N-66750

URINE A-00220, A-00375, A-01687, A-02312, A-02653, A-02988, A-03450, A-17116, A-17405, B-02541, C-00126, C-00260, C-00264, C-00626, C-00636, C-00941, C-01349, C-01793, C-03503, C-18264, C-26744, C-43570, C-47193, C-60410, C-77492, D-47982, F-07714, F-34948, G-01338, G-01674, G-01728, G-01794, G-06485, G-06497, G-10203, G-12987, G-14112, G-14477, G-19880, G-23563, G-24126, G-24392, G-24720, G-26461, G-26846, G-26873, G-27753, G-27755, G-28754, G-29415, G-29807, G-31234, G-32601, G-32606, G-33505, G-33511, G-33766, G-36947, G-37569, G-37684, G-38106, G-38942, G-40920, G-44362, G-44590, G-44593, G-44594, G-47905, G-48636, G-48637, G-49164, G-49607, G-50318, G-50371, G-50419, G-52686, G-54302, G-56931, G-62177, G-62596, G-71324, G-74380, G-74821, G-74822, G-76902, G-79619, G-79623, G-79634, G-79796, G-81181, G-83177, G-83798, H-00187, H-00240, H-00265, H-00266, H-00301, H-00600, H-00631, H-00633, H-00654, H-00788, H-00920, H-00944, H-00964, H-00979, H-01092, H-01250, H-01398, H-01506, H-01557, H-01664, H-01705, H-01800, H-01809, H-02041, H-02049, H-02200, H-02379,

H-02382, H-02537, H-03116, H-03360, H-03395, H-03472, H-03549, H-03570, H-03571, H-03572, H-03611, H-03612, H-03613, H-03616, H-03629, H-03676, H-03729, H-03860, H-03873, H-04816, H-04924, H-05612, H-06353, H-06354, H-12554, H-18268, H-18269, H-18270, H-20015, H-20707, H-25735, H-26734, H-28031, H-28035, H-32736, H-39493, H-40201, H-40368, H-46997, H-48167, H-48193, H-49434, H-65103, K-03582
USSR A-04068, A-08486, A-11916, A-17076, A-23022, A-26329, A-42731, A-53955, A-63661, A-68807, A-76411, A-81169, B-13771, B-23310, B-26279, B-26317, B-27569, B-32384, B-37115, B-37544, B-37745, B-38188, B-38775, B-38974, B-40414, B-41932, B-45380, B-47821, B-58632, B-66618, B-80356, B-80863, C-02565, C-04105, C-10632, C-27131, C-32450, C-36125, C-36771, C-37799, C-41064, C-46303, C-46784, C-48392, C-51551, C-56572, C-65118, C-73471, C-74354, C-76030, C-79835, D-07579, D-17642, D-34008, D-37823, E-29910, F-15927, F-21632, F-68048, G-06675, G-08201, G-10247, G-10333, G-11942, G-12282, G-32596, G-32601, G-32605, G-32606, G-33510, G-33511, G-33561, G-35670, G-36411, G-37139, G-41224, G-41685, G-41686, G-41687, G-45055, G-52147, G-59073, G-66668, G-68583, G-72083, H-22496, H-22930, H-23188, H-23295, H-26978, H-27091, H-36159, H-63167, H-75027, H-84484, K-10168, K-11414, K-27010, K-28466, K-41682, K-58638, K-68582, L-44054
UTAH A-02312, G-04849, G-23763, H-00301, H-01092, H-04848, L-44598

V

VALLEYS D-09590, D-33309, D-39182, E-14897, E-33092, G-24580, G-30788, G-40597, H-00301, H-15604, H-16567, H-24395, H-29991, H-32289, H-32535, H-32536, H-36996, H-46997, I-07553, I-63871
VANADIUM COMPOUNDS A-09785, A-27314, A-49617, A-52741, A-59257, A-74154, A-75077, A-76638, A-80238, A-81343, A-81931, C-41064, C-53523, C-55789, C-61957, C-82552, D-50307, D-78193, E-29910, E-33579, E-43424, G-34398, G-36723, G-52029, G-61146, G-71484, G-71933, G-80857, H-13474, I-47291, K-41682, K-51057, K-68224, K-72145
VAPOR PRESSURE A-05811, A-31581, A-77993, B-51755, C-01349, H-25273, I-00085
VAPOR RECOVERY SYSTEMS A-60281, B-18641, B-33971, B-39104, B-42078, B-49031
VAPORS A-08882, A-27314, A-32702, A-39862, A-40180, A-43403, A-59494, A-65064, A-71477, A-74262, A-76411, A-80507, B-16962, B-25523, B-25590, B-26674, B-28783, B-33971, B-37536, B-38115, B-38593, B-42078, B-47186, B-49031, B-65638, B-66618, B-70840, B-71297, B-84418, C-16801, C-19076, C-24114, C-36125, C-41020, C-44552, C-44933, C-80259, E-44030, F-18427, F-62189, G-28199, G-33276, G-34398, G-71933, H-23661, H-25750, H-28477, H-36742, H-50780, H-54066
VARNISHES AND SHELLAC A-32855, I-30696
VEGETABLES A-11453, B-02541, B-37402, C-00626, C-00941, C-04757, C-18230, C-18264, C-29467, D-09590, G-05504, G-11444, G-13700, G-19215, G-43896, G-83177, H-00187, H-00240, H-00265, H-00266, H-00301, H-00631, H-00964, H-01506, H-01800, H-02200, H-02382, H-03395, H-03571, H-03612, H-03613, H-03616, H-03629, H-03729, H-03873, H-04683, H-04728, H-04732, H-04984, H-05724, H-06413, H-06557, H-08513, H-08884, H-09683, H-10150, H-10673, H-11100, H-11466, H-12042, H-13203, H-13247, H-14247, H-15213, H-15604, H-16245, H-16387, H-16900, H-17449, H-17705, H-18266, H-19657, H-19863, H-20400, H-20872, H-21000, H-21364, H-21501, H-22284, H-22624, H-23222, H-23386, H-24330, H-24358, H-24366, H-24548, H-24852, H-25099, H-26717, H-27805, H-28427, H-28437, H-28446, H-28480, H-28483, H-28600, H-29443, H-29597, H-30142, H-30805, H-31208, H-32339, H-34880, H-35880, H-36787, H-36994, H-36996, H-37346, H-39098, H-39159, H-40202, H-40599, H-41439, H-41699, H-42958, H-43492, H-45007, H-47286, H-50157, H-52306, H-52698, H-56241, H-56521, H-58777, H-60559, H-67026, H-76838, H-77390, H-78956, H-79972, H-80064, H-80067, H-80536, H-80575, H-81495, H-83854, H-83885, H-84551, H-84553, H-84651, K-07605, K-26738, L-06754, L-24010
VEHICULAR TRAFFIC A-76274, D-78193, E-76047
VENTILATION A-00640, A-04068, A-06371, A-22875, A-27314, A-27930, A-42751, A-48429, A-50018, A-68807, A-71477, A-82279, B-15372, B-23370, B-28945, B-30519, B-32231, B-32712, B-33191, B-35513, B-36532, B-37293, B-38082, B-44838, B-52179, B-80213, D-06809, E-44030, G-00165, G-01096, G-16916, K-10168
VENTILATION (PULMONARY) G-38942, G-84266
VENTURI SCRUBBERS A-01125, A-05090, A-09332, A-09693, A-12889, A-35985, A-41650, A-41877, A-47962, A-60827, A-65064, A-71615, A-76122, A-76152, B-04794, B-06587, B-07815, B-09902, B-15813, B-21034, B-22484, B-22913, B-29680, B-29725, B-32232, B-33971, B-36552, B-37914, B-38115, B-41418, B-43299, B-43481, B-44716, B-44838, B-45078, B-45380, B-45544, B-45707, B-47054, B-47086, B-49023, B-49929, B-51101, B-52172, B-52838, B-60075, B-64092, B-64696, B-76512, B-81256, B-83667, E-29315, G-40527
VESSELS (MARINE) A-09785, D-33017, D-42760, G-28139, L-25427, L-29421
VETERINARY MEDICINE H-01092, H-12533, H-12554
VIRUSES A-32702, G-02539, G-30788, H-00240, H-17705, H-21501, H-33127, H-60559, H-62275, H-80575
VISIBILITY A-02312, A-08116, A-09785, A-28038, A-32060, A-34018, A-36045, A-60281, A-75206, A-76152, A-81861, C-39022, C-69152, D-09590, D-26702, D-39737, G-19148, I-24308, K-07605, K-58638, L-32173, N-44066, N-66750
VISIBLE RADIATION C-22879, C-80259, H-11157, H-24064
VISUAL PROPERTIES H-78580
VOLATILITY A-18469, A-33853, A-44681, A-57231, A-71273, A-75146, A-77993, A-79511, B-22923, B-55180, B-56528, C-24114, C-44933, C-57079, H-29597
VOLCANOES A-32576, A-39862, A-40600, A-43403, A-49738, A-79567, A-82944, D-23862, D-66083, E-40271, F-20932
VOLTAGE C-04685, C-08077, I-00695
VOLTMETERS C-01313

W

WASHINGTON (STATE) A-00375, C-26909, D-23760, H-00301, H-02200, H-22887, L-44598
WASHINGTON D C D-24736, D-52578, G-26743, H-01809, L-09677
WASHOUT A-44566, B-10618, E-29774, H-56428, H-62597
WASTE GAS CONTROL A-00896, A-15452, A-18323, A-22875, A-32519, A-34096, A-34334, A-38657, A-42675, A-43014, A-46925, A-47188, A-47962, A-47965, A-47966, A-55212, A-57231, A-60727, A-60728, A-60866, A-63661, A-82192, B-12288, B-15322, B-16555, B-17463, B-18641, B-18826, B-18830, B-20436, B-22943, B-23182, B-24033, B-24333, B-25038, B-25178, B-25638, B-26908, B-27282, B-28709, B-28889, B-29680, B-29725, B-30276, B-30519, B-30814, B-31889, B-31920, B-31918, B-35106, B-35111, B-35513, B-36755, B-37603, B-38299, B-38476, B-40381, B-40712, B-41378, B-42083, B-42104, B-43108, B-44716, B-44793, B-44838, B-45707, B-45846, B-47054, B-47086, B-47256, B-47341, B-47731, B-48480, B-48805, B-48811, B-48879, B-50937, B-51101, B-51845, B-52445, B-53603, B-53620, B-53868, B-54799, B-56057, B-56591, B-59679, B-60075, B-60255, B-60849, B-60864, B-61935, B-63474, B-64977, B-65640, B-67700, B-68795, B-69965, B-71472, B-72656, B-74480, B-74483, B-75387, B-77816, B-78814, B-78890, B-79079, B-80500, B-81256, B-81995, B-83134, B-83198, C-00126, C-21806, C-22877, C-23575, C-29426, C-55858, C-61103, D-35764, D-47976, D-49860, E-14897, F-44721, H-39537, H-41696, J-29923, L-24122, L-39306, I-42873, N-50867, N-64545, N-64937
WASTE GASES A-00896, A-01125, A-01528, A-02847, A-03565, A-04068, A-05139, A-05140, A-05587, A-05871, A-08102, A-08116, A-08748, A-09214, A-09321, A-09332, A-09341, A-09651, A-09690, A-09692, A-09693, A-09694, A-09695, A-09696, A-09697, A-09799, A-11341, A-11590, A-11876, A-11877, A-12470, A-12474, A-12587, A-12622, A-12676, A-12692, A-12740, A-12747, A-12750, A-12773, A-12809, A-12822, A-12828, A-12884, A-12886, A-12888, A-12889, A-12919, A-12929, A-12931, A-12933, A-13452, A-17344, A-22875, A-23022, A-24039, A-26329, A-28652, A-29519, A-30218, A-30517, A-31144, A-31315, A-31529, A-32519, A-33735,

A-33853, A-34534, A-35985, A-37190, A-37562, A-40344, A-40401, A-42675, A-42676, A-42677, A-42680, A-42682, A-42683, A-43116, A-45858, A-46925, A-47945, A-47962, A-47966, A-49886, A-50018, A-52277, A-52508, A-52912, A-53295, A-54622, A-55407, A-57231, A-58334, A-58370, A-58402, A-58939, A-59494, A-60281, A-60727, A-60728, A-60866, A-61154, A-61183, A-61570, A-63661, A-65064, A-67748, A-67834, A-68703, A-68823, A-69309, A-69422, A-70069, A-70727, A-71615, A-72125, A-74154, A-75089, A-76274, A-76644, A-77367, A-77522, A-79043, A-79511, A-80994, A-81861, A-81916, A-81917, A-81931, A-81935, A-82192, A-82353, A-82944, B-04794, B-07664, B-08344, B-10618, B-15322, B-16555, B-17463, B-17485, B-18641, B-18698, B-18699, B-18826, B-18830, B-19177, B-21034, B-22040, B-22484, B-22598, B-22943, B-23182, B-24110, B-24333, B-24355, B-24834, B-25195, B-25433, B-25658, B-26317, B-26401, B-27569, B-28709, B-29403, B-29680, B-30276, B-30519, B-30814, B-31567, B-31708, B-31889, B-32232, B-32384, B-32461, B-32627, B-32712, B-32963, B-33918, B-35106, B-35111, B-36716, B-37402, B-37544, B-37603, B-37809, B-38082, B-38115, B-38439, B-38476, B-38504, B-38587, B-38593, B-40251, B-40381, B-40712, B-40892, B-41378, B-42078, B-42083, B-42104, B-42172, B-42287, B-43108, B-43481, B-43533, B-44121, B-44716, B-45078, B-45254, B-45846, B-47054, B-47086, B-47095, B-47125, B-47186, B-47256, B-47341, B-47463, B-47466, B-47821, B-48143, B-48805, B-48811, B-48814, B-48879, B-49031, B-49420, B-49477, B-49979, B-50154, B-50652, B-51101, B-51720, B-51755, B-51845, B-52179, B-52445, B-52838, B-52852, B-53620, B-53867, B-53868, B-54310, B-54799, B-55678, B-56057, B-56078, B-56528, B-56531, B-56591, B-58580, B-58466, B-58632, B-58879, B-58993, B-59230, B-59679, B-59845, B-59861, B-60075, B-60206, B-60255, B-60849, B-61259, B-61273, B-61741, B-61935, B-62165, B-62786, B-63474, B-63540, B-63775, B-63784, B-64070, B-64092, B-64428, B-64506, B-64696, B-64898, B-64977, B-65640, B-66592, B-66624, B-66947, B-67136, B-67137, B-67217, B-67700, B-68633, B-68795, B-69131, B-69528, B-69965, B-70428, B-70537, B-70658, B-70659, B-70840, B-71297, B-71472, B-71623, B-71796, B-71841, B-72038, B-72656, B-73031, B-73175, B-74480, B-74483, B-75204, B-75387, B-76232, B-77475, B-77816, B-78814, B-78890, B-79079, B-79657, B-79711, B-80213, B-80500, B-80863, B-81256, B-81645, B-81772, B-81773, B-81944, B-81995, B-82032, B-82446, B-82918, B-83198, B-83667, C-03119, C-06112, C-06397, C-18230, C-22812, C-22877, C-23575, C-25223, C-26713, C-29737, C-30793, C-30958, C-31115, C-32631, C-33632, C-35108, C-35737, C-35956, C-37463, C-37579, C-38670, C-39136, C-41624, C-43570, C-44238, C-49391, C-49476, C-52992, C-53876, C-55367, C-55858, C-59049, C-59513, C-60278, C-60553, C-60951, C-61103, C-61896, C-67528, C-68086, C-69174, C-70638, C-70686, C-72015, C-73349, C-74221, C-75058, C-76212, C-79842, C-82650, C-84182, C-84214, D-23760, D-25093, D-26702, D-33858, D-37502, D-41979, D-56463, D-77485, D-77512, E-14897, E-29774, E-33579, E-37639, E-44277, E-59075, E-59234, E-78943, F-44721, G-18785, G-31319, G-32601, G-32607, G-33510, G-33511, G-39219, G-40527, G-40597, G-40635, G-44597, G-67325, G-67440, G-74369, G-79848, G-83179, H-08884, H-11452, H-18226, H-21189, H-21422, H-23214, H-23295, H-23386, H-23950, H-24024, H-24064, H-24395, H-25865, H-26734, H-28647, H-29736, H-31733, H-32535, H-32539, H-32714, H-36787, H-37480, H-38017, H-38404, H-38412, H-38417, H-38574, H-39493, H-39537, H-39684, H-41370, H-41696, H-41898, H-42501, H-42857, H-43492, H-44295, H-45160, H-46198, H-47385, H-51109, H-51321, H-56874, H-57475, H-58777, H-59327, H-59935, H-60690, H-60913, H-65179, H-67453, H-69596, H-74588, H-74624, H-76233, H-77377, H-77391, H-80067, H-80079, H-81288, H-81671, H-81771, H-83258, H-83854, H-83856, I-58585, I-65935, J-38409, J-39910, J-41121, J-76213, K-34063, K-36823, K-37472, K-58899, K-66860, K-66916, K-68582, K-78880, K-80854, K-81864, L-09677, L-17188, L-19064, L-19434, L-20273, L-24481, L-29421, L-30620, L-33722, L-38573, L-38669, L-39306, L-39749, L-48719, L-59722, L-64940, N-63776, N-64545, N-64937, N-65407

WATER A-39862, B-07552, B-26244, B-33971, B-41932, B-46086, B-47341, B-47821, B-55524, B-66592, B-69528, B-71412, B-79711, C-01793, C-04463, C-15355, C-25806, D-33425, F-19175, F-21632, F-62189, G-06485, G-26743, G-28019, G-37569, G-37795, G-43896, G-45055, H-22496, H-28031, H-33290, H-37403, H-46923, H-64427, I-40510

WATER BODIES A-32139, A-35985, A-37996, A-39587, A-40182, A-48048, A-74154, A-74262, A-80334, A-83543, B-24683, B-25038, B-28320, B-28502, B-32232, B-40251, B-41569, B-43840, B-47677, B-47680, B-47731, B-47821, B-49023, B-49031, B-51845, B-56057, B-79657, C-23518, C-36002, C-38280, C-38670, C-44710, C-47193, C-50936, C-58278, D-30058, D-31371, D-33108, D-41979, D-44267, D-56465, G-32152, G-32601, G-39494, G-43323, G-46085, G-52557, H-32291, H-32673, H-32736, H-33290, H-35992, H-37403, H-37567, H-39923, H-71098, I-23108, I-39031, K-37472, K-74109, L-27677, L-28349, L-29421, L-43007, L-48788, L-73836, L-77234, N-63463

WATER POLLUTION A-32139, A-35985, A-37996, A-39587, A-40182, A-48048, A-74154, A-74262, A-80334, A-83543, B-24683, B-25038, B-28320, B-28502, B-32232, B-40251, B-41569, B-43840, B-47677, B-47680, B-47731, B-47821, B-49023, B-49031, B-51845, B-56057, B-79657, C-23518, C-36002, C-38280, C-38670, C-44710, C-47193, C-50936, C-58278, D-30058, D-31371, D-33108, D-41979, D-44267, D-56465, G-32152, G-32601, G-39494, G-43323, G-46085, G-52557, H-32291, H-32673, H-32736, H-33290, H-35992, H-37403, H-37567, H-39923, H-71098, I-23108, I-39031, K-37472, K-74109, L-27677, L-28349, L-29421, L-43007, L-48788, L-73836, L-77234, N-63463

WATER VAPOR A-76411, A-80507

WAVELENGTHS C-80227, C-80259

WEATHER MODIFICATION A-34334, E-72995, G-38616, H-46198, I-24308, N-66750

WEIGHT C-83495

WEST AND GAEKE METHOD (SO2) C-00126, C-02681, C-05078, C-11574, C-22877, C-30014, C-32476, C-39022, C-43985, C-61993, K-08420

WEST VIRGINIA D-09590, D-56792, L-09677

WET CYCLONES A-01687, A-05090, A-09697, A-09799, A-63661, B-04368, B-04794, B-06587, B-07190, B-07815, B-08344, B-09773, B-09902, B-15813, B-17463, B-22943, B-29680, B-32231, B-37914, B-38082, B-40414, B-43299, B-45078, B-47054, B-47095, B-52838, B-60075, B-81773, B-84418

WETTING H-42946

WHEAT B-02541, C-20701, H-11466, H-17710, H-20158, H-29277, H-32854, H-42958, H-56213, H-56963, H-63442, H-70607, H-81495

WIND ROSE D-37502

WIND TUNNELS A-53874, A-66955

WINDS A-00220, A-07650, A-09785, A-28652, A-31581, A-32576, A-32702, A-48048, A-50018, A-66955, A-68703, A-79511, B-19571, B-25195, B-42083, B-45468, C-07710, C-22877, C-29771, C-36800, C-44177, C-48392, C-68944, D-01872, D-09590, D-22348, D-23760, D-26086, D-31371, D-32666, D-33017, D-33108, D-33858, D-36806, D-37502, D-39054, D-40896, D-43170, D-43317, D-44267, D-44799, D-48791, D-50550, D-54881, D-58218, D-58427, D-73835, D-77485, E-02325, E-05054, E-29023, E-33092, E-37013, E-37037, E-37639, E-44277, E-49433, E-76047, E-78793, G-33510, H-16567, H-25661, H-28149, H-28647, H-30301, H-31527, H-32714, H-36996, H-38412, H-42601, H-51470, H-58777, H-60907, H-69162, H-80064, H-82435, I-47291, L-40889, N-04212, N-63776, N-69692

WISCONSIN L-44598

WOOD (MATERIAL) A-36377, A-40344, A-45858, A-69039, C-23096, I-63139, J-48171

WOOLS A-43272, B-05567, B-07552, I-07553

WYOMING K-51229

X

X-RAY FLUORESCENCE SPECTROMETRY C-79032, C-83442

X-RAYS C-32534, C-42375, C-53523, C-64779, C-82650, D-52578, G-07013, G-49164

XYLENES C-38670, C-80259, K-51057

Y

YOKOHAMA H-48941

Z

ZINC A-17471, A-30517, A-40182, A-42676, A-43014, A-45858, A-49924, A-55212, A-60728, B-07815, B-28786, B-51755, C-09770, D-09590, H-08884, H-21422, H-48167, I-23108, I-40510, I-40833, I-46606, J-30696, L-59722

ZINC COMPOUNDS A-09783, A-09799, A-27314, A-30447, A-30517, A-32702, A-37190, A-40344, A-43014, A-50938, A-51100, A-52741, A-54622, A-60728, A-60729, A-61564, A-64926, A-71477, A-74262, A-75077, A-76638, A-80238, A-80994, A-81343, A-81931, B-25178, B-28786, B-32461, B-45380, B-58879, B-80950, C-28126, C-32476, C-39136, C-39516, C-39719, C-42928, C-50936, C-55789, C-72017, C-75339, C-82552, D-49260, D-50307, D-69144, D-83399, G-34398, G-36723, G-38721, G-52029, G-54302, G-71933, H-04544, H-08884, H-11452, H-13474, H-28475, H-32736, H-35880, H-38332, H-43492, H-45467, H-47286, H-48167, H-48193, H-50729, H-50959, H-51754, H-61496, H-65103, H-65179, H-67348, H-68770, H-71078, H-76297, H-77325, H-84290, K-44310, K-51057, K-68224, K-74109, L-17472, L-41455, L-82278

ZINC PRIMARY SMELTING AND REFINING B-83134

ZIRCONIUM I-40510

TECHNICAL REPORT DATA
(Please read Instructions on the reverse before completing)

1. REPORT NO.	2.	3. RECIPIENT'S ACCESSION NO.
EPA-450/1-76-003		

4. TITLE AND SUBTITLE	5. REPORT DATE
FLUORINE, ITS COMPOUNDS, AND AIR POLLUTION: A BIBLIOGRAPHY WITH ABSTRACTS	December 1976
	6. PERFORMING ORGANIZATION CODE
7. AUTHOR(S)	8. PERFORMING ORGANIZATION REPORT NO.
9. PERFORMING ORGANIZATION NAME AND ADDRESS Environmental Protection Agency Air Pollution Technical Information Center Research Triangle Park, N. C. 27711	10. PROGRAM ELEMENT NO.
	11. CONTRACT/GRANT NO.
12. SPONSORING AGENCY NAME AND ADDRESS	13. TYPE OF REPORT AND PERIOD COVERED
	14. SPONSORING AGENCY CODE EPA

15. SUPPLEMENTARY NOTES

16. ABSTRACT

The Air Pollution Technical Information Center (APTIC) of EPA's Office of Air Quality Planning and Standards prepared, selected and compiled the approximately 2600 abstracts in this bibliography. The abstracts are arranged within 14 general subject categories. The abstracted documents are thought to be representative of available literature. Subject and author indexes are included. The indexes refer to the abstracts by a category code and abstract number. The author index lists all authors individually; primary authorship is indicated by an asterisk. Generally, higher abstract numbers have been assigned to more recent documents. The aim of this bibliography is to bring together these abstracts which were previously scattered throughout "Air Pollution Abstracts" (1970-1976).

17. KEY WORDS AND DOCUMENT ANALYSIS

a. DESCRIPTORS	b. IDENTIFIERS/OPEN ENDED TERMS	c. COSATI Field/Group
Air Pollution Information Retrieval Fluorine Fluorides Hydrofluoric Acid Bibliographies Abstracts Indexes (Documentation)	Fluorosis	13 B

18. DISTRIBUTION STATEMENT	19. SECURITY CLASS (This Report)	21. NO. OF PAGES
Release to Public	Unclassified	602
	20. SECURITY CLASS (This page)	22. PRICE
	Unclassified	

EPA Form 2220-1 (9-73)

*U.S. GOVERNMENT PRINTING OFFICE--1977--740-104/406